



Calexico Intermodal Transportation Center

TECHNICAL PROJECT SPECIFICATIONS

**Issued For:
Bid Documents**

February 1, 2024

ICTC CALEXICO INTERMODAL TRANSPORTATION CENTER TECHNICAL PROJECT SPECIFICATIONS

February 1, 2024

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THESE SPECIFICATIONS, THE LATEST EDITION OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION 2021 (GREENBOOK) AND THE LATEST EDITION OF THE CALTRANS STANDARD SPECIFICATIONS 2018.

DIVISION 01 – GENERAL REQUIREMENTS

- 01 10 00 SUMMARY OF THE WORK
- 01 30 00 BASIC ADMINISTRATIVE REQUIREMENTS
- 01 40 00 QUALITY REQUIREMENTS
- 01 57 13 TEMPORARY EROSION CONTROL
- 01 60 00 PRODUCT REQUIREMENTS
- 01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS
- 01 78 00 CLOSEOUT SUBMITTALS
- 01 79 00 DEMONSTRATION AND TRAINING
- 01 91 13 GENERAL COMMISSIONING REQUIREMENTS

DIVISION 03 – CONCRETE

- 03 10 00 CONCRETE FORMING AND ACCESSORIES
- 03 20 00 CONCRETE REINFORCING
- 03 30 00 CAST-IN-PLACE CONCRETE
- 03 35 16.13 CONCRETE FLOOR SEALING – HARDENING – DENSIFYING COMPOUNDS
- 03 35 43 POLISHED CONCRETE FINISHING

DIVISION 04 – MASONRY

- 04 22 00 CONCRETE MASONRY UNITS
- 04 26 13 MASONRY VENEER

DIVISION 05 - METALS

- 05 12 00 STRUCTURAL STEEL FRAMING
- 05 12 13 ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING
- 05 31 00 STEEL DECKING
- 05 50 00 METAL FABRICATIONS
- 05 52 13 PIPE AND TUBE RAILINGS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 53 MISCELLANEOUS ROUGH CARPENTRY
06 16 00 SHEATHING
06 41 16 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS
06 61 16.13 SOLID SURFACING COUNTERTOPS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 21 00 THERMAL INSULATION
07 26 16 BELOW-GRADE VAPOR RETARDERS
07 27 26 FLUID-APPLIED MEMBRANE AIR BARRIERS
07 41 13.16 STANDING SEAM METAL ROOF PANELS
07 42 13 METAL WALL PANELS
07 54 23 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING
07 62 00 SHEET METAL FLASHING AND TRIM
07 72 00 ROOF ACCESSORIES
07 84 13 PENETRATION FIRESTOPPING
07 84 43 JOINT FIRESTOPPING
07 92 00 JOINT SEALANTS

DIVISION 08 – OPENINGS

08 11 13 HOLLOW METAL DOORS AND FRAMES
08 31 13 ACCESS DOORS AND FRAMES
08 51 13 ALUMINUM WINDOWS
08 56 19 TICKET WINDOWS
08 71 00 DOOR HARDWARE
08 80 00 GLAZING
08 91 19 FIXED LOUVERS

DIVISION 09 – FINISHES

09 22 16 NON-STRUCTURAL METAL FRAMING
09 29 00 GYPSUM BOARD
09 30 13 CERAMIC TILING
09 51 13 ACOUSTICAL PANEL CEILINGS
09 65 13 RESILIENT BASE AND ACCESSORIES
09 91 13 EXTERIOR PAINTING
09 91 23 INTERIOR PAINTING
09 96 23 GRAFFITI-RESISTANT COATINGS

DIVISION 10 – SPECIALTIES

10 14 23.13 ROOM-IDENTIFICATION SIGNAGE
10 28 13 TOILET LAUNDRY ACCESSORIES
10 44 13 FIRE PROTECTION CABINETS
10 44 16 FIRE EXTINGUISHERS

DIVISION 12 – FURNISHINGS

12 24 13 ROLLER WINDOW SHADES

DIVISION 22 – PLUMBING

22 05 00 BASIC PLUMBING REQUIREMENTS
22 05 29 PLUMBING PIPE SLEEVES, SUPPORTS, GUIDES AND ANCHORAGES
22 05 53 PLUMBING SYSTEMS IDENTIFICATION
22 07 00 PLUMBING INSULATION
22 11 00 WATER SUPPLY SYSTEM (PLUMBING)
22 13 00 SANITARY SEWER SYSTEM
22 33 00 DOMESTIC WATER HEATERS
22 40 00 PLUMBING FIXTURES

DIVISION 23 – HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 05 00 COMMON WORK RESULTS FOR HVAC
23 05 13 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 93 HVAC TESTING, ADJUSTING, AND BALANCING
23 07 00 HVAC INSULATION
23 08 00 COMMISSIONING OF HVAC
23 23 00 REFRIGERANT PIPING
23 30 00 HVAC AIR DISTRIBUTION
23 31 13 DUCTWORK AND ACCESSORIES
23 34 16 CENTRIFUGAL HVAC FANS
23 37 13 DIFFUSERS, REGISTERS, AND GRILLES
23 81 26 SPLIT SYSTEM AIR CONDITIONERS

DIVISION 26 – ELECTRICAL

26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 44 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
26 05 53 ELECTRICAL IDENTIFICATION
26 05 73 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
26 09 23 LIGHTING CONTROL DEVICES
26 09 43 NETWORK LIGHTING CONTROLS
26 24 13 SWITCHBOARDS
26 24 16 PANELBOARDS
26 27 26 WIRING DEVICES
26 28 13 FUSES
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 51 00 INTERIOR LIGHTING
26 56 00 EXTERIOR LIGHTING

DIVISION 27 – COMMUNICATIONS

- 27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS
- 27 05 44 SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING
- 27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS
- 27 13 00 COMMUNICATIONS BACKBONE CABLING
- 27 15 00 COMMUNICATIONS HORIZONTAL CABLING

DIVISION 31 – EARTHWORK

- 31 10 00 SITE CLEARING
- 31 11 50 DEMOLITION
- 31 20 00 EARTHWORK
- 31 23 16 TRENCHING

DIVISION 32 - EXTERIOR IMPROVEMENTS

- 32 11 23 AGGREGATE BASE COURSES
- 32 12 16 ASPHALT PAVING
- 32 13 13 CONCRETE PAVING - VEHICULAR
- 32 13 16 DECORATIVE CONCRETE PAVING
- 32 13 73 CONCRETE PAVING JOINT SEALANTS
- 32 17 23 PAVEMENT MARKINGS
- 32 17 26 TACTILE WARNING SURFACING
- 32 80 00 IRRIGATION
- 32 90 00 PLANTING

DIVISION 33 – UTILITIES

- 33 05 00 INSTALATION OF BURIED PIPE
- 33 10 00 WATER DISTRIBUTION
- 33 13 00 DISINFECTION OF WATER UTILITY PIPING SYSTEMS
- 33 14 00 HYDROSTATIC TESTING OF PRESSURE PIPELINES
- 33 30 00 SANITARY SEWER PIPING AND APPURTENANCES
- 33 41 00 STORM UTILITY DRAINAGE PIPING

END OF TABLE OF CONTENTS

**SECTION 01 10 00
SUMMARY OF THE WORK**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Definitions
- C. Summary of Work Included in this Contract

1.02 RELATED DOCUMENTS

- A. Construction Drawings, Technical Specifications, Addenda, and general provisions of the contract, including Contract General Conditions and Supplementary General Conditions and other Division 01 Specification Sections, apply to this Section.
- B. The latest edition of the Standard Specification for Public Works Construction 2021 (Greenbook).
- C. The latest edition of Caltrans Standard Specification 2018.
- D. **Federal Transit Administration (FTA) Funding Requirements** – Project shall conform to the “**FTA Project and Construction Management Guidelines**,” dated March 2016.
- E. **Federal Transit Administration (FTA) “Best Practices Procurement & Lessons Learned Manual,”** dated October 2016

1.03 DEFINITIONS

- A. The word “Owner” shall mean the Imperial County Transportation Commission.
- B. The word “City” shall mean the City of Calexico, California.
- C. The word “Contractor” shall mean the party of the second part entering into the contract with the Owner for the performance of work required by these specifications, and legal representatives of said party, or agent appointed to act for said party in the performance of the work.
- D. The word “Public Works Director/City Engineer” shall mean the City of Calexico Public Works Director/City Engineer, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.
- E. The word “Greenbook” shall mean the Standard Specification for Public Works Construction.

1.04 SUMMARY OF WORK INCLUDED IN THIS CONTRACT

- A. All work (labor, materials, equipment, construction, coordination, meetings, etc.) involved in the construction of the project as shown on the plans and as described in the specifications. Work includes on-site demolition, grading, and civil improvements, on-site sewer, water and storm drain improvements, bus shelters, operator and ticket building, electrical/lighting, on-site landscape, irrigation and site furnishings, and offsite improvements; all included within the Drawings.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

**SECTION 01 23 00
ALTERNATIVES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Procedures

1.02 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.

1.03 SUMMARY

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

1.04 DEFINITIONS

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

1.05 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - a. Include as each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Alternatives will be exercised at Owner's opinion.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Action Submittals
- E. Quality Assurance
- F. Procedures
- G. Substitutions

1.02 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.

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.
- B. Related Requirements:
 - 1. Section 01 23 00 "Alternates" for products selected under an alternate.
 - 2. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.04 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
- B. Purpose: Substitutions will only be considered where Owner will receive benefit or because specified materials are no longer available due to conditions beyond Contractor's control.
 - 1. Owner benefits either from a Contractor proposed reduction of the Contract amount or from a reduction in Contract time based on acceptance of proposed substitution.
 - 2. List proposed cost or time reductions on request for substitution.

1.05 ACTION SUBMITTALS

- A. Substitution Requests: Submit each request electronically for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use e-mail of form provided in Project Manual.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of Architects and Owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect/Engineer Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect/Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect/Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.06 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.07 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.08 SUBSTITUTION

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 1. Conditions: Architect/Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - i. Substitutions will not be considered for acceptance when:

- i. They are indicated or implied on submittals without a formal request from Contractor.
 - ii. They are requested directly by a subcontractor or supplier.
 - iii. Acceptance will require substantial revision of Contract Documents.
 - iv. Requests not including a proposed cost or time reduction will not be considered unless Contractor submits supporting information indicating specified materials are not available.
 - j. Owner and Architect/Engineer will determine acceptability of proposed substitutions and reserves right to reject proposals due to insufficient information.
- 2. Substitutions for Convenience: Architect/Engineer will consider requests for substitution if received within 35 days after the Notice of Award of Contract. Requests received after that time may be considered or rejected at discretion of Architect/Engineer.
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect/Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - k. See notes 'i' and 'j' at A. Substitution of Cause.
- 3. Contractor's representation
 - a. Requests constitute a representation that Contractor:
 - i. Has investigated proposed product and determined it meets or exceeds, in all respects, specified product.
 - ii. Will provide the same warranty or longer warranty for substitution as for specified product.

- iii. Will coordinate installation and make other changes that may be required for work to be completed in all respected.
 - iv. Waives claims for additional costs that subsequently become apparent.
 - v. Will pay costs of changes to Contract Documents, drawings, details, and specifications required by accepted substitutions.
 - vi. Will identify the products by Reference Standards: Select product meeting referenced standard for products specified only by reference standard.
4. Architect/Engineer's Duties
- a. Review contractor's requests for substitutions with reasonable promptness.
 - i. Architect/Engineer will recommend that Owner accept or reject substitution request.
 - ii. Upon request, Architect/Engineer will provide cost for changes to Contract Documents, drawings, details and specifications required for substitutions.
 - b. Notify Contractor in writing of decision to accept or reject requested substitution.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

**SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Minor Changes in the Work
- D. Proposal Requests
- E. Change Order Procedures
- F. Construction Change Directive

1.02 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.

1.03 MINOR CHANGES IN THE WORK

- A. Architect/Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time on AIA Document G710.

1.04 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect/Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect/Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request [**20 days, when not otherwise specified,**] after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- e. Quotation Form: Use forms provided by Owner. Sample copies are included in Project Manual.

1.05 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect/Engineer will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.06 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect/Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 30 00
BASIC ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Progress meetings.
- B. Construction progress schedule.
- C. Submittals for review, information, and project closeout.
- D. Number of copies of submittals.
- E. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- B. Section 01 78 00 - Closeout Submittals: Project record documents.
- C. Section 01 91 13 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.
 - 1. Where submittals are indicated for review by both Architect/Engineer and the Commissioning Agent, submit one extra and route to Engineer First, for forwarding to the Commissioning Agent.
 - 2. Where submittals are not indicated to be reviewed by Architect/Engineer, submit directly to Commissioning Agent; otherwise, the procedures specified in this section apply to commissioning submittals.

1.03 PROJECT COORDINATION

- A. Make the following types of submittals to Architect/Engineer through Owner:
 - 1. Requests for Information.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Manufacturer's instructions and field reports.
 - 6. Applications for payment and change order requests shall be submitted directly to ICTC.
 - 7. Progress schedules.
 - 8. Coordination drawings.
 - 9. Closeout submittals.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 PROGRESS MEETINGS

- A. A preconstruction meeting shall be scheduled prior to the start of work.
- B. Schedule and administer meetings throughout progress of the Work at weekly intervals.
- C. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

- D. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.
- E. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Maintenance of progress schedule.
 - 7. Corrective measures to regain projected schedules.
 - 8. Planned progress during succeeding work period.
 - 9. Maintenance of quality and work standards.
 - 10. Effect of proposed changes on progress schedule and coordination.
 - 11. Other business relating to Work.
- F. Record minutes and distribute electronic copies within two days after meeting to participants, Architect/Engineer, Owner, and those affected by decisions made.

3.02 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 5 working days.
- C. Within 10 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule monthly.

3.03 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Submit to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - CLOSEOUT SUBMITTALS.

3.04 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.

4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect/Engineer's knowledge as contract administrator or to Owner.

3.05 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:

1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

B. Submit for Owners benefit during and after project completion.

3.06 NUMBER OF COPIES FOR SUBMITTALS

A. Documents for Review:

1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit electronic copies at Contractor request, plus an electronic copy that will be retained by Architect/Engineer and forwarded to Owner.
2. Larger Sheets, Not Larger Than 30 x 42 inches: Submit electronic copies at Contractor request, plus an electronic copy that will be retained by Architect/Engineer and forwarded to Owner.

B. Documents for Information: Submit electronic copy.

C. Samples: Submit the number specified in individual specification sections; two of which will be retained by Architect/Engineer and ICTC.

1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

3.07 SUBMITTAL PROCEDURES

A. Submittals Schedule:

1. Comply with Number of Copies of Submittals paragraph above for list of submittals and time requirements for scheduled performance of related construction activities.
2. Provide Submittals Schedule to Owner and Architect/Engineer along with Construction Progress Schedule.

B. Transmit each submittal with approved form.

C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.

E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

F. Deliver submittals to Architect/Engineer at business address or via email.

- G. Schedule submittals to expedite the Project, and coordinate submission of related items.
- H. For each submittal for review, allow 10 working days excluding delivery time to and from the Contractor.
- I. For each submittal for Concurrent review, allow a minimum of 15 working days, excluding delivery time to and from the Contractor. Forward to each consultant for review as needed.
- J. For Requests for Information allow 10 working days for Architect/Engineer review.
- K. If intermediate submittal for review is necessary, process in the same manner as Initial Submittal.
- L. No extension of Contract time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- M. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- N. Provide space for Contractor and Architect/Engineer review stamps.
- O. When revised for resubmission, identify all changes made since previous submission.
- P. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- Q. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Related Requirements
- D. Definitions
- E. Informational Submittals
- F. General Coordination Procedures
- G. Coordination Drawings
- H. Request for Information (RFI)
- I. Digital Project Management Procedures
- J. Project Meetings

1.02 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.

1.03 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.04 DEFINITIONS

- A. BIM: Building Information Modeling.

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

1.05 INFORMATIONAL SUBMITTALS

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

1.06 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

1.07 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, electrical, and plumbing systems, such as Ceiling Spaces.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect/Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

1.08 REQUEST FOR INFORMATION (RFI)

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

3. Date.
 4. Name of Contractor.
 5. Name of Architect/Engineer and Construction Manager.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in PDF format.
- D. Architect/Engineer's and Construction Manager's Action: Architect/Engineer and Construction Manager will review each RFI, determine action required, and respond. Allow 7 working days for Architect/Engineer's response for each RFI. RFIs received by Architect/Engineer or Construction Manager after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect/Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect/Engineer's action may include a request for additional information, in which case Architect/Engineer's time for response will date from time of receipt by Architect/Engineer or Construction Manager of additional information.
 3. Architect/Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect/Engineer and Construction Manager in writing within 10 working days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log biweekly. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect/Engineer and Construction Manager.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect/Engineer's and Construction Manager's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect/Engineer's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect/Engineer and Construction Manager within 7 working days if Contractor disagrees with response.

1.09 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect/Engineer's Data Files Not Available: Architect/Engineer will not provide Architect/Engineer's BIM model CAD drawing digital data files for Contractor's use during construction.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect/Engineer, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.10 PROJECT MEETINGS

- A. General: Schedule and conduct Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect/Engineer of scheduled meeting dates and times a minimum of 10 working days prior to meeting.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect/Engineer, within 3 days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect/Engineer, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect/Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.

- w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
 - cc. Build America By America (BABA) Requirements/Regulations
 - dd. FTA Funding Requirements/Regulations
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect/Engineer, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.

- q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct Construction Manager will conduct progress meetings at weekly (7 days) intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect/Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - i. Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - i. Interface requirements.
 - ii. Sequence of operations.
 - iii. Status of submittals.

- iv. Deliveries.
- v. Off-site fabrication.
- vi. Access.
- vii. Site use.
- viii. Temporary facilities and controls.
- ix. Progress cleaning.
- x. Quality and work standards.
- xi. Status of correction of deficient items.
- xii. Field observations.
- xiii. Status of RFIs.
- xiv. Status of Proposal Requests.
- xv. Pending changes.
- xvi. Status of Change Orders.
- xvii. Pending claims and disputes.
- xviii. Documentation of information for payment requests.

- 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Informational Submittals
- E. Quality Assurance
- F. Coordination
- G. Contractor's Construction Schedule, General
- H. Startup Construction Schedule
- I. CPM Schedule Requirements
- J. Reports

1.02 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.

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Unusual event reports.

1.04 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time belongs to Owner is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.05 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF file.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Unusual Event Reports: Submit at time of unusual event.
- H. Qualification Data: For scheduling consultant.

1.06 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect/Engineer's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including phasing work stages area separations and interim milestones.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.
 6. Review submittal requirements and procedures.
 7. Review time required for review of submittals and resubmittals.
 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 10. Review and finalize list of construction activities to be included in schedule.
 11. Review procedures for updating schedule.

1.07 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.08 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice of Award to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect/Engineer.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect/Engineer's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.

2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.

- f. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- J. Distribution: Distribute copies of approved schedule to Architect/Engineer, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.09 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.10 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice of Award. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work the Notice of Award.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time- scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, sustainable design documentation, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect/Engineer.

- b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 - 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 - 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

- b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.11 REPORT

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Work Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.

- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
 - 1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Submittal Schedule
- E. Submittal Format
- F. Submittal Procedures
- G. Submittal Requirements
- H. Delegated – Design Services
- I. Contractor’s Review
- J. Architect’s and Construction Manager’s Review

1.02 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.

1.03 SUMMARY

- A. Section includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
 - 2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 4. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 5. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.

6. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.04 DEFINITIONS

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

1.05 SUBMITTAL SCHEDULE

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

- e. Description of the Work covered.
- f. Scheduled date for Architect/Engineer's and Construction Manager's final release or approval.

1.06 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect/Engineer.
 - 4. Name of Construction Manager.
 - 5. Name of Contractor.
 - 6. Name of firm or entity that prepared submittal.
 - 7. Names of subcontractor, manufacturer, and supplier.
 - 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 - 9. Category and type of submittal.
 - 10. Submittal purpose and description.
 - 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 12. Drawing number and detail references, as appropriate.
 - 13. Indication of full or partial submittal.
 - 14. Location(s) where product is to be installed, as appropriate.
- B. Options: Identify options requiring selection by Architect/Engineer.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect/Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.07 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package, and transmit to Architect/Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect/Engineer.
 - a. Architect/Engineer, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect/Engineer and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer's Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect/Engineer Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow - 10 days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect/Engineer's consultants, Owner, or other parties is indicated, allow 20 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect/Engineer and to Architect/Engineer's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect/Engineer Construction Manager, through Architect/Engineer, before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect/Engineer and Construction Manager.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect/Engineer's and Construction Manager's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect/Engineer's and Construction Manager's action stamp.

1.08 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.

- h. Availability and delivery time information.
- 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. BIM Incorporation: Develop and incorporate Construction Manager will incorporate Contractor's Shop Drawing files into BIM established for Project.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.

4. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect/Engineer and Construction Manager will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - i. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - ii. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

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

1.09 DELEGATED – DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect/Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: Incorporate Construction Manager will incorporate delegated-design drawing and data files into BIM established for Project.
 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.10 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect/Engineer and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Architect/Engineer and Construction Manager will review each submittal, indicate corrections or revisions required, and return it.
 1. PDF Submittals: Architect/Engineer will indicate, via markup on each submittal, the appropriate action.
 2. Submittals by Web-Based Project Software: Architect/Engineer will indicate, on Project software website, the appropriate action.
- B. Informational Submittals: Architect/Engineer and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect/Engineer and Construction Manager will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect/Engineer and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

- E. Architect/Engineer and Construction Manager will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect/Engineer without action.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 35 15

CALGREEN ENVIRONMENTAL REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Summary
- B. Environmental Requirements

1.01 SUMMARY

- A. Comply with CALGreen environmental requirements related to energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and environmental quality.

1.02 ENVIRONMENTAL REQUIREMENTS

- A. Mandatory Measures: Comply with CALGreen Mandatory Measures applicable to Project.
 - 1. Design team and construction team are each required to participate to maximum degree possible to achieve CALGreen environmental requirements.
 - 2. Contract Documents are not intended to limit alternative means of achieving environmental requirements.
 - a. Suggestions from Contractor, subcontractors, suppliers, and manufacturers for achieving environmental requirements are encouraged; team approach is also encouraged.
- B. Requirements: Construction team is required to review CALGreen requirements relative to Project related to following.
 - 1. Energy Efficiency: Comply with California Energy Commission requirements.
 - 2. Water Efficiency and Conservation: Comply with requirements for both indoor and outdoor water use.
 - 3. Material Conservation and Resource Efficiency:
 - a. Construction Waste: Provide construction waste management plan as defined by CALGreen.
 - b. Building Maintenance and Operation: Provide operation and maintenance data as required by CALGreen.
 - 4. Environmental Quality: Comply with following as applicable to Project and as required by CALGreen. with following as
 - a. Mechanical Equipment Pollution Control: Cover duct and related air distribution component openings to prevent dust and debris accumulation.

- b. Finish Material Pollution Control: Comply with CALGreen requirements for volatile organic compound (VOC) emissions including but not necessarily limited to following (as applicable):
 - i. Adhesives, sealants and caulks.
 - ii. Paints and coatings.
 - iii. Carpet systems including carpet, carpet cushion, and adhesives.
 - iv. Resilient flooring systems.
 - v. Composite wood products formaldehyde limitations.
 - c. Interior Moisture Control: Comply with CALGreen requirements.
 - d. Building Material Moisture Content: Do not use water damaged building materials, remove and place wet and high moisture content insulation, and do not enclose wall or floor framing when moisture content exceeds 19%.
 - e. Indoor Air Quality: Outside air delivery. For mechanically or naturally ventilated spaces in buildings, meet the minimum requirements of Section 120.1 of the California Energy Code or the applicable local code, whichever is more stringent, and Division 1, Chapter 4 of CCR, title 8.
 - f. Environmental Comfort: Comply with CALGreen requirements.
- C. Planning and Design: Construction team shall coordinate with Design Team regarding Project Planning and Design methods related to CALGreen requirements related to Project design and shall comply with requirements related to construction.

PART 2 – GENERAL

2.01 SECTION INCLUDES

- A. Materials
- B. Substitutions
- C. Protection

2.02 MATERIALS

- A. General Issues: Do not use materials with moisture stains or with signs of mold or mildew.
 - 1. Moisture Stains: Materials that have evidence of moisture damage, including stains, are not acceptable, including both stored and installed materials; immediately remove from site.
 - 2. Mold and Mildew: Materials that have evidence of growth of molds or of mildew are not acceptable, including both stored and installed materials; immediately remove from site.

2.03 SUBSTITUTIONS

- A. Substitutions Environmental Issues: Requests for substitutions shall comply with requirements specified in Section 01630 – Product Substitution Procedures, with following additional information required where environmental issues are involved.
 - 1. Indicate each proposed substitution complies with CALGreen requirements.
 - 2. Owner and Architect/Engineer reserve right to reject proposed substitutions where CALGreen information is not provided and where substitution may impact mandatory requirements or Project voluntary tier requirements.

PART 3 – PRODUCTS

3.01 SUBSTITUTIONS

- A. Environmental Issues: Protect interior materials from water damage; where interior products not intended for wet applications are exposed to moisture, immediately remove from site.
 - 1. Protect installed products using methods that do not support growth of molds and mildews. Immediately remove from site materials with mold and materials with mildew.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. References and standards.
- B. Quality assurance submittals.
- C. Mock-ups.
- D. Control of installation.
- E. Tolerances.
- F. Testing and inspection services.
- G. Manufacturers' field services.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2019.
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2017.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2022.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2019.
- E. ASTM E329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2013.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.

1.04 SUBMITTALS

- A. Testing Agency Qualifications:
 - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full-time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Design Data: Submit for Engineers knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit electronic copy of report to Engineer and to Contractor.
 - 1. Include:
 - a. Date issued.

- b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Engineer, provide interpretation of results.
2. Test report submittals are for Engineers knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Engineer, in quantities specified for Product Data.
- 1. Indicate material or product conforms to or exceeds specified requirements.
Submit supporting reference data, affidavits, and certifications as appropriate.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for Engineers benefit as contract administrator or for Owner.
- 1. Submit report within 30 days of observation to Engineer for information.
 - 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- G. Erection Drawings: Submit drawings for Engineers benefit as contract administrator or for Owner.
- 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
 - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.05 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.06 TESTING AND INSPECTION AGENCIES

- A. Owner will employ and pay for services of an independent testing agency to perform selected other specified testing and inspection.
- B. Contractor shall employ and pay for services of an independent testing agency to perform specified testing and inspection, unless indicated by Owner.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.
 - 2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
 - 3. Laboratory: Authorized to operate in California.
 - 4. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.
 - 5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step-in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.

- D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by Engineer.
 - 6. Attend preconstruction meetings and progress meetings if requested.
 - 7. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Engineer.
- F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and systems as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 10 days in advance of required observations.
 - 1. Observer subject to approval of Engineer.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Owner, it is not practical to remove and replace the Work, Engineer will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 42 00
REFERENCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Definitions
- C. Industry Standards
- D. Abbreviations and Acronyms

1.02 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.

1.03 DEFINITIONS

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

1.04 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect

as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.05 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO – Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC – American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA – American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI – American Concrete Institute; (Formerly: ACI International); www.concrete.org
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 12. AGA - American Gas Association; www.aga.org.
 - 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 16. AIA - American Institute of Architects (The); www.aia.org.
 - 17. AISC - American Institute of Steel Construction; www.aisc.org.
 - 18. AISI - American Iron and Steel Institute; www.steel.org.
 - 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 20. AMCA – Air Movement and Control Association International, Inc.; www.amca.org.
 - 21. ANSI - American National Standards Institute; www.ansi.org.
 - 22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 - 23. APA - APA - The Engineered Wood Association; www.apawood.org.
 - 24. APA - Architectural Precast Association; www.archprecast.org.

25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA – Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA – BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE – Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA – Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.

59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA – Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. FTA – Federal Transit Administration
91. GA - Gypsum Association; www.gypsum.org.
92. GANA - Glass Association of North America; www.glasswebsite.com.
93. GS - Green Seal; www.greenseal.org.
94. HI - Hydraulic Institute; www.pumps.org.

95. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
96. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
98. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
99. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
100. IAS - International Accreditation Service; www.iasonline.org.
101. IAS - International Approval Services; (See CSA).
102. ICBO - International Conference of Building Officials; (See ICC).
103. ICC - International Code Council; www.iccsafe.org.
104. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
105. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
106. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
107. IEC - International Electrotechnical Commission; www.iec.ch.
108. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
109. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
110. IESNA - Illuminating Engineering Society of North America; (See IES).
111. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
112. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
113. IGSHPA – International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
114. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
115. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
116. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
117. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
118. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
119. ISO - International Organization for Standardization; www.iso.org.
120. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
121. ITU - International Telecommunication Union; www.itu.int/home.
122. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
123. LMA - Laminating Materials Association; (See CPA).
124. LPI - Lightning Protection Institute; www.lightning.org.
125. MBMA - Metal Building Manufacturers Association; www.mbma.com.
126. MCA - Metal Construction Association; www.metalconstruction.org.
127. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
128. MFMA – Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.

129. MHIA - Material Handling Industry of America; www.mhia.org.
130. MIA - Marble Institute of America; www.marble-institute.com.
131. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
132. MPI - Master Painters Institute; www.paintinfo.com.
133. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
134. NAAMM – National Association of Architectural Metal Manufacturers; www.naamm.org.
135. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
136. NADCA - National Air Duct Cleaners Association; www.nadca.com.
137. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
138. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
139. NBI - New Buildings Institute; www.newbuildings.org.
140. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
141. NCMA - National Concrete Masonry Association; www.ncma.org.
142. NEBB - National Environmental Balancing Bureau; www.nebb.org.
143. NECA - National Electrical Contractors Association; www.necanet.org.
144. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
145. NEMA - National Electrical Manufacturers Association; www.nema.org.
146. NETA - InterNational Electrical Testing Association; www.netaworld.org.
147. NFHS - National Federation of State High School Associations; www.nfhs.org.
148. NFPA - National Fire Protection Association; www.nfpa.org.
149. NFPA - NFPA International; (See NFPA).
150. NFRC - National Fenestration Rating Council; www.nfrc.org.
151. NHLA - National Hardwood Lumber Association; www.nhla.com.
152. NLGA - National Lumber Grades Authority; www.nlga.org.
153. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
154. NOMMA – National Ornamental & Miscellaneous Metals Association; www.nomma.org.
155. NRCA - National Roofing Contractors Association; www.nrca.net.
156. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
157. NSF - NSF International; www.nsf.org.
158. NSPE - National Society of Professional Engineers; www.nspe.org.
159. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
160. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
161. NWFA - National Wood Flooring Association; www.nwfa.org.
162. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
163. PDI - Plumbing & Drainage Institute; www.pdionline.org.
164. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); <http://www.plasa.org>.
165. RCSC - Research Council on Structural Connections; www.boltcouncil.org.

166. RFCI - Resilient Floor Covering Institute; www.rfci.com.
167. RIS - Redwood Inspection Service; www.redwoodinspection.com.
168. SAE - SAE International; www.sae.org.
169. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
170. SDI - Steel Deck Institute; www.sdi.org.
171. SDI - Steel Door Institute; www.steeldoor.org.
172. SEFA – Scientific Equipment and Furniture Association (The); www.sefalabs.com.
173. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
174. SIA - Security Industry Association; www.siaonline.org.
175. SJI - Steel Joist Institute; www.steeljoist.org.
176. SMA - Screen Manufacturers Association; www.smainfo.org.
177. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
178. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
179. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
180. SPIB - Southern Pine Inspection Bureau; www.spib.org.
181. SPRI - Single Ply Roofing Industry; www.spri.org.
182. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
183. SSINA - Specialty Steel Industry of North America; www.ssina.com.
184. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
185. STI - Steel Tank Institute; www.steeltank.com.
186. SWI - Steel Window Institute; www.steelwindows.com.
187. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
188. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
189. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
190. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
191. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
192. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
193. TMS - The Masonry Society; www.masonrysociety.org.
194. TPI - Truss Plate Institute; www.tpinst.org.
195. TPI - Turfgrass Producers International; www.turfgrasssod.org.
196. TRI - Tile Roofing Institute; www.tilerroofing.org.
197. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
198. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
199. USAV - USA Volleyball; www.usavolleyball.org.
200. USGBC - U.S. Green Building Council; www.usgbc.org.
201. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.

202. WA - Wallcoverings Association; www.wallcoverings.org
203. WASTEC - Waste Equipment Technology Association; www.wastec.org.
204. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
205. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
206. WDMA - Window & Door Manufacturers Association; www.wdma.com.
207. WI - Woodwork Institute; www.wicnet.org.
208. WSRCA - Western States Roofing Contractors Association; www.wsra.com.
209. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL – Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.

18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. BABA – Build America Buy America
 2. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 3. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 4. DSCC - Defense Supply Center Columbus; (See FS).
 5. FED-STD - Federal Standard; (See FS).
 6. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 7. MILSPEC - Military Specification and Standards; (See DOD).
 8. USAB - United States Access Board; www.access-board.gov.
 9. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestsERVICE.tamu.edu.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 43 39
LARGE MOCK-UPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Summary
- B. Design and Performance Requirements
- C. Submittals
- D. Quality Assurance

1.02 SUMMARY

- A. Section Includes:
 - 1. Construction of a free-standing building mock-up to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination and operation of various building components.
 - 2. Additional Material Mock-ups: As required by the Specifications.
- B. Related Sections: Review requirements specified in other appropriate Sections for materials incorporated into the mock-up.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Design Concept: Mock-up shown on the mock-up drawings is intended to permit verification of workmanship and visual qualities of the final completed installation.
 - 1. Include, as part of the mock-up, required bracing and anchorage.
 - 2. Make necessary additions and modifications to the details shown on the mock-up drawings as may be required to comply with specified performance requirements while maintaining the design concept.
- B. Performance: Mock-up shall be constructed for testing by Owner for compliance with the Contract Documents to the extent specified herein.
- C. Accepted mock-up shall be used as a visual standard for the final installation and, to the extent tested, performance requirements specified.

1.04 SUBMITTALS

- A. General:
 - 1. Review all Sections.
 - 2. Procedures: In accordance with Section 01 33 00, "Submittal Procedures."
- B. Quality Control:

1. Although a temporary structure, Contractor shall submit documentation that building mock-up has been fabricated to meet structural requirements is if requested by governing authorities.
2. Report of field testing on window elements of mock-up if testing is required.

1.05 QUALITY ASSURANCE

- A. Mock-up components shall be finished as required for completed installation including selected colors.
- B. Make necessary modifications or fabricate new components as requested and required to comply with specified performance requirements while maintaining the design concept.
- C. Obtain Architect/Engineer's approval of mock-ups before starting work, fabrication, or construction.
- D. Allow in Construction Schedule a minimum of 7 days for initial review and each re-review of mockup.

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

- A. Materials

2.02 MATERIALS

- A. General: Materials for the mock-up shall be as shown and specified in the respective Specification Sections.

PART 3 – EXECUTION

3.01 SECTION INCLUDES

- A. Examination
- B. Construction
- C. Review and Acceptance
- D. Maintenance
- E. Removal and Salvage

3.02 EXAMINATION

- A. Examine site and area established by the Owner to receive mock-up and conditions under which mock-up is to be constructed. Deficiencies shall be brought to the attention of the Owner and corrected as directed.

3.03 CONSTRUCTION

- A. Erect a full-size building mock-up.
- B. Mock-up shall include, but not be limited to, the following components and materials:
 - 1. Cast-in-place concrete slab with finish representative of typical interior concrete slab finish.
 - 2. Each type of window specified, including hardware.
 - 3. Sliding vinyl and glass door, including hardware.
 - 4. Portland cement plaster.
 - 5. Exterior Clading.
 - 6. Interior opening trim.
 - 7. Roofing membrane and sheet metal vent.
 - 8. Gutters and downspouts.
 - 9. Exterior design lighting fixtures.
 - 10. Exterior bricks
- C. Mock-up shall be erected on site within the limits of work at a location to be determined by the Owner.
- D. Construct mock-up as shown on Drawings and in accordance with reviewed submittals, complete with all required fastenings, bracing, and other elements, plumb and true, firmly erected and anchored.
- E. Anchorage and assembly shall conform to code requirements for seismic stability.
- F. Coordinate mock-up construction with delivery and assembly of related materials and components to be included in the mock-up.
- G. Additional Mock-ups and Field Samples: As specified in the various Sections.
 - 1. Mock-ups shall remain on site and shall be readily identifiable to serve as standard for judging the performance of the complete work.
 - 2. Where appropriate, these mock-ups and field samples, when accepted, may be incorporated into the finished work subject to approval of the Architect/Engineer.

3.04 REVIEW AND ACCEPTANCE

- A. Upon completion of mock-up construction, notify the Owner and make arrangement for review, evaluation, and any testing required by the Owner.
- B. Modify the mock-up, or construct new components if requested by the Owner until final acceptance is obtained.
- C. Following acceptance, mock-up shall serve as a visual standard of quality and appearance of the work it represents, including interface with adjacent materials and components.

3.05 MAINTENANCE

- A. Maintain mock-ups in a neat, clean, and “as accepted by Owner” condition.

3.06 REMOVAL AND SALVAGE

- A. Except at otherwise specified or approved by the Owner, materials used in accepted mock-ups shall not be incorporated into the Project.
- B. Remove all mock-ups prior to completion of Project but not before the work they are being used to judge has been accepted by the Owner.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Use Charges
- D. Informational Submittals
- E. Quality Assurance
- F. Project Conditions

1.02 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.

1.03 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 31 20 00 "Earth Moving" for disposal of ground water at Project site.

1.04 USE CHARGES

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

- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges.
- G. Provide connections and extensions of services as required for construction operations.
- H. Sewer, Water, and Electric Power Service: Use charges are specified in Section 01 12 00 "Multiple Contract Summary."

1.05 INFORMATIONAL SUBMITTALS

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

1.06 INFORMATIONAL SUBMITTALS

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

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

1.07 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

- A. Materials
- B. Temporary Facilities
- C. Equipment

2.02 MATERIALS

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

2.03 TEMPORARY FACILITIES

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

2.04 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction [.] and clean HVAC system as required in Section 01 77 00 "Closeout Procedures."

- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 – EXECUTION

3.01 SECTION INCLUDES

- A. Temporary Facilities, General
- B. Installation, General
- C. Temporary Utility Installation
- D. Support Facilities Installation
- E. Security and Protection Facilities Installation
- F. Moisture and Mold Control
- G. Operation, Termination, and Removal

3.02 TEMPORARY FACILITIES, GENERAL

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

3.03 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.04 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

- B. Connect temporary sewers to municipal system as directed by Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- F. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA- filter-equipped vacuum equipment.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment land-based telephone line(s) for each field office.
 1. Provide additional telephone lines for the following:
 - a. Provide one telephone line(s) for Owner's use.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect/Engineer's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
- L. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect/Engineer and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 1. Processor: Intel Core i5 or i7.
 2. Memory: 4 gigabyte.
 3. Disk Storage: 500 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 4. Display: 24-inch LCD monitor with 256-Mb dedicated video RAM.
 5. Full-size keyboard and mouse.
 6. Network Connectivity: 10/100BaseT Ethernet.
 7. Operating System: Microsoft Windows 7 Professional.
 8. Productivity Software:
 - a. Microsoft Office Professional, 2010 or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader 11.0 or higher.
 - c. WinZip 7.0 or higher.
 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.

10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.0 Mbps upload and 15 Mbps download speeds at each computer.
11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
12. Backup: External hard drive, minimum 2 terabyte, with automated backup software providing daily backups.

3.05 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect/Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00 "Earth Moving."
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 32 12 16 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.

- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Elevator Use: Use of elevators is not permitted.
- L. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- N. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

- O. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.06 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 31 10 00 "Site Clearing."
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection: Comply with requirements specified in Section 01 56 39 "Temporary Tree and Plant Protection."
- G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

- H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- I. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- J. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- K. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- L. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- M. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
 - 1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 - 2. Paint and maintain appearance of walkway for duration of the Work.
- N. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- O. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18

- inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
- a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 6. Protect air-handling equipment.
 7. Provide walk-off mats at each entrance through temporary partition.
- P. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.07 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.

2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect/Engineer.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.08 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Performance bond.
- E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. 31 10 00 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 31 20 00 - Earthwork: Temporary and permanent grade changes for erosion control.
- C. Section 32 11 23 - Aggregate Base Courses: Temporary and permanent roadways.
- D. Section 32 90 00- Planting: Permanent plantings for erosion control.

1.03 REFERENCE STANDARDS

- A. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2021.
- B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999, Published 2014.
- C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.
- D. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2009.
- E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2021.
- F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2021
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.
- H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; Federal Highway Administration; 1995.

1.04 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the current Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Best Management Practices Standard: Federal Highway Administration Best Management Practices for Erosion and Sediment Control.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- E. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
- F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

- J. Sedimentation of Waterways On and Off Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
 - 1. Submit within 2 weeks after Notice to Proceed.
 - 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 - 3. Obtain the approval of the Plan by authorities having jurisdiction.
 - 4. Obtain the approval of the Plan by Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- E. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Straw or hay.
 - 2. Erosion control matting or burlap netting.
- B. Bales: Air dry, rectangular straw bales.
 - 1. Cross Section: 14 by 18 inches, minimum.

2. Bindings: Twine around long dimension.
- C. Bale Stakes: One of the following, minimum 3 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
 2. Wood, 2 by 2 inches in cross section.
- D. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355 after 500 hours exposure.
 4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632.
 6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D4533.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- E. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
 2. Wood, 2 by 2 inches in cross section.
- F. Gravel: See Section 32 11 23 for aggregate.
- G. Fiber rolls:
1. Burlap or plastic free netting.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTATIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.

- b. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - c. Across the entrances to culverts that receive runoff from disturbed areas.
 - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet.
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 12-inch overlap at joints.
 - 3. Place and compact at least 6 inches of 1.5-to-3.5-inch diameter stone.
- B. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D4873.
 - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16-inch-high barriers with minimum 36-inch-long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 - 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28-inch-high barriers, minimum 48-inch-long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 - 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32-inch-high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 - 5. Install with top of fabric at nominal height and embedment as specified.
 - 6. Embed bottom of fabric in a trench on the upslope side of fence, with 6 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
 - 7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 - 8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.

9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.

C. Straw Bale Rows:

1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Mulching Over Small and Medium Areas:

1. Dry Straw and Hay: Apply 4 to 6 inches depth.
2. Erosion Control Matting: Comply with manufacturer's instructions.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

- B. Repair deficiencies immediately.

C. Silt Fences:

1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Straw Bale Rows:

1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bales.
3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

- E. Clean out temporary sediment control structures weekly and relocate soil on site.

- F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect/Engineer.

- B. Clean out temporary sediment control structures that are to remain as permanent measures.

- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Product quality monitoring.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

1.03 BUILD AMERICA BUY AMERICA REQUIREMENTS

- A. The Contractor must comply with the Build America Buy America requirements as outlined in FAR Subpart 25.2 at the Federal Acquisition Regulation website.

1.04 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each submittal to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 – PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.

- B. If the Contractor wishes to furnish or use substitute materials, equipment, or processes in connection with this Contract, the Contractor shall make a written application to Owner for consideration of the substitute, together with a certification by the Contractor that the proposed substitute will adequately perform the functions called for in the project design, is of similar and equal substance to the equipment, material, or process named, is suited to the same use, complies with all codes, laws, or regulations affecting the Work and is capable of performing the same function as the materials, equipment, or process named in the Contract Documents. Substitutions shall be provided at no additional cost or time impact to the project. The Contractor is responsible to coordinate all associated work that may be affected by the substitution. The application shall also state whether or not acceptance of the substitute will require a change in the Contract Documents to adapt the design to the substitute and whether or not the use of the substitute is subject to payment of any license fee or royalty by the Contractor. The Contractor shall reimburse the Owner for costs associated with review of the substitution.
- C. Do not use products having any of the following characteristics:
 - 1. Made using or containing CFC's or using HCFC's in the manufacturing process.
 - 2. Made of wood from newly cut old growth timber.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 - EXECUTION

3.01 SUBSTITUTION MATERIALS

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- D. Substitution Submittal Procedure:

1. Submit request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. The Engineer will notify Contractor in writing of decision to accept or reject request.

3.02 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return and re-use of packing materials, such as wood pallets, where feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Prevent contact with material that may cause corrosion, discoloration, or staining.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, except payment procedures.
- I. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.
- C. Section 01 57 13 - Temporary Erosion and Sedimentation Control: Additional erosion and sedimentation control requirements.
- D. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- E. Section 01 91 13 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.
- F. Individual Product Specification Sections:
 - 1. Advance notification to other sections of openings required in work of those sections.

1.03 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
 - 2. Identify demolition firm and submit qualifications.
 - 3. Include a summary of safety procedures.

- D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Effect on work of Owner or separate Contractor.
 - f. Written permission of affected separate Contractor.
 - g. Date and time work will be executed.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
 - 1. Minimum of five years of documented experience.
- B. For survey work, employ a land surveyor registered in California and acceptable to Architect/Engineer. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in California.

1.06 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
 - 1. Pest Control Service: Weekly treatments.
- H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 – PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.

- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect/Engineer four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 1. Review conditions of examination, preparation and installation procedures.
 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect/Engineer of any discrepancies discovered.
- C. Owner will locate and protect survey control and reference points.
- D. Control datum for survey is that established by Owner provided survey.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.
- H. Utilize recognized engineering survey practices.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 2. Grid or axis for structures.
 3. Building foundation, column locations, ground floor elevations.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.
- L. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-conforming work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- I. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.09 SYSTEM STARTUP

- A. Coordinate with requirements of Section 01 91 13 - General Commissioning Requirements.
- B. Coordinate schedule for start-up of various equipment and systems.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 79 00 - Demonstration and Training.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.12 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect/Engineer and Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in Contractor's Notice of Substantial Completion.
- C. Notify Architect/Engineer when work is considered ready for Substantial Completion.
- D. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- E. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.
- F. Accompany Project Coordinator on preliminary final inspection.
- G. Notify Architect when work is considered finally complete.
- H. Complete items of work determined by Architect/Engineer's final inspection.

3.14 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 73 00

EXECUTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Preinstallation Meetings
- E. Information Submittals
- F. Quality Assurance

1.02 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.

1.03 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.

1.04 DEFINITIONS

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

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor professional engineer.

- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

1.06 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect/Engineer of locations and details of cutting and await directions from Architect/Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect/Engineer's opinion, reduce the building's aesthetic

- qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

- A. Materials

2.02 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect/Engineer for the visual and functional performance of in-place materials.

PART 3 – EXECUTION

3.01 SECTION INCLUDES

- A. Examination
B. Preparation
C. Construction Layout
D. Field Engineering
E. Installation
F. Cutting and Patching
G. Owner-Installed Products
H. Progress Cleaning
I. Starting and Adjusting
J. Protection of Installed Construction

3.02 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework,

investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.03 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect/Engineer according to requirements in Section 01 31 00 "Project Management and Coordination."

3.04 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect/Engineer and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish limits on use of Project site.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect/Engineer and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect/Engineer and Construction Manager promptly.
- D. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

3.05 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect/Engineer or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect/Engineer and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.06 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect/Engineer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.07 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as

invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.08 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.09 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.10 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.11 PROTECTION OF INSTALLED CONSTRUCTION

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

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Material of Ownership
- E. Action Submittals
- F. Informational Submittals
- G. Quality Assurance
- H. Waste Management Plan

1.02 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.

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 04 22 00 "Concrete Unit Masonry" for disposal requirements for masonry waste.
 - 2. Section 31 10 00 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.04 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.05 MATERIALS OWNERSHIP

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

1.06 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.07 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.08 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

1.09 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site- clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

- A. Performance Requirements

2.02 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 65 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 1. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Carpet and pad.
 - i. Gypsum board.
 - j. Piping.
 - k. Electrical conduit.
 1. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - i. Paper.
 - ii. Cardboard.
 - iii. Boxes.
 - iv. Plastic sheet and film.
 - v. Polystyrene packaging.
 - vi. Wood crates.

- vii. Wood pallets.
- viii. Plastic pails.
- m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - i. Paper.
 - ii. Aluminum cans.
 - iii. Glass containers.

PART 3 – EXECUTION

3.01 SECTION INCLUDES

- A. Plan Implementation
- B. Salvaging Demolition Waste
- C. Recycling Demolition and Construction Waste, General
- D. Recycling Demolition Waste
- E. Recycling Construction Waste
- F. Disposal of Waste

3.02 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.

2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.03 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- E. Plumbing Fixtures: Separate by type and size.
- F. Lighting Fixtures: Separate lamps by type and protect from breakage.
- G. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.04 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.05 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
1. Crush concrete and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as satisfactory soil for fill or subbase.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
1. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- I. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

- J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- K. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- L. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- M. Conduit: Reduce conduit to straight lengths and store by material and size.
- N. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.06 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Section 32 93 00 "Plants" for use of clean sawdust as organic mulch.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in Section 32 93 00 "Plants" for use of clean ground gypsum board as inorganic soil amendment.
- D. Paint: Seal containers and store by type.

3.07 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Action Submittals
- D. Closeout Submittals
- E. Maintenance Material Submittals
- F. Substantial Completion Procedures
- G. List of Incomplete Items (Punch List)
- H. Submittal of Project Warranties

1.02 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.

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. Related Requirements:
 - 1. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.04 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at final completion.

1.05 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.06 MAINTENANCE MATERIAL SUBMITTALS

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

1.07 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect Construction Manager. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's Construction Manager's Owner's signature for receipt of submittals.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.

4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.08 LIST OF INCOMPLETE (PUNCH LIST)

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

- a. MS Excel electronic file. Architect, through Construction Manager, will return annotated file.
- b. PDF electronic file. Architect, through Construction Manager, will return annotated file.

1.09 SUBMITTAL OF PROJECT WARRANTIES

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

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

- A. Materials

2.02 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 – EXECUTION

3.01 SECTION INCLUDES

- A. Final Cleaning

3.02 SECTION INCLUDES

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even- textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.

- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision- obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - i. Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect/Engineer with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Owner will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Owner comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:

ICTC Callexico Intermodal Transit Center

CLOSEOUT SUBMITTALS

IFB Deliverable

01 78 00 - 1

02/01/24

1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- C. Include color coded wiring diagrams as installed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Include test and balancing reports.
- N. Additional Requirements: As specified in individual product specification sections.

3.05 OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.

- C. Binders: Commercial quality, 8-1/2 by 11-inch three D side ring binders with durable plastic covers; 2-inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 20-pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Certificates.
 - c. Photocopies of warranties and bonds.
- J. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- K. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

ICTC Calxico Intermodal Transit Center

CLOSEOUT SUBMITTALS

IFB Deliverable

01 78 00 - 4

02/01/24

- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11-inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Summary
- C. Definitions
- D. Closeout Submittals
- E. Format of Operation and Maintenance Manuals
- F. Requirements for Emergency, Operation, and Maintenance Manuals
- G. Operation and Maintenance Documentation Directory Manual
- H. Emergency Manuals
- I. Systems and Equipment Operation Manuals
- J. Systems and Equipment Maintenance Manuals
- K. Product Maintenance Manuals

1.02 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.

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.04 DEFINITIONS

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

1.05 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect/Engineer will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect/Engineer by email or by uploading to web- based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect/Engineer will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect/Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Architect/Engineer's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.06 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.07 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

1.08 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

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

1.09 EMERGENCY MANUALS

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

1.10 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.

6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.11 SYSTEMS AND MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.12 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Record Documents
- B. Summary
- C. Closeout Submittals
- D. Record Drawings
- E. Record Specifications
- F. Record Product Data
- G. Miscellaneous Record Submittals
- H. Maintenance of Record Documents

1.02 RECORD DOCUMENTS

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

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for final property survey.
 - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one 1 set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Final Submittal:

- i. Submit one paper-copy set(s) of marked-up record prints.
 - ii. Submit PDF electronic files of scanned record prints and one set(s) of prints.
 - iii. Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy 1 paper copies annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy 1 paper copies annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy 1 paper copies annotated PDF electronic files and directories of each submittal.
- E. Update Project Record Documents daily and allow for Architect/Engineer inspection at least once a month.

1.05 RECORD DRAWINGS

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

- g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect/Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect/Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect/Engineer through Construction Manager for resolution.
 4. Architect/Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of Architect/Engineer's digital data files.
 - b. Architect/Engineer will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.

- b. Date.
- c. Designation "PROJECT RECORD DRAWINGS."
- d. Name of Architect/Engineer and Construction Manager.
- e. Name of Contractor.

1.06 RECORD SPECIFICATION

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

1.07 RECORD PRODUCT DATA

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

1.08 MISCELLANEOUS RECORD SUBMITTALS

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

1.09 MISCELLANEOUS RECORD SUBMITTALS

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

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Electrical systems and equipment.
 - 4. Conveying systems.
 - 5. Landscape irrigation.
 - 6. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.
- B. Section 01 91 13 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.
- C. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word preferred.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Commissioning Authority for review and inclusion in overall training plan.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.

- b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such a slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
- 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
- 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
 - 4. Include Commissioning Authority's formal acceptance of training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
- 1. Format: electronic.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
- 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.

- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. Owner will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum two-hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
 1. Review the applicable O&M manuals.
 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 6. Discuss common troubleshooting problems and solutions.
 7. Discuss any peculiarities of equipment installation or operation.

8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 10. Review spare parts and tools required to be furnished by Contractor.
 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 01 91 13

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion
- C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.
- D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
 - 1. Plumbing Systems
 - 2. HVAC System, including:
 - a. Major and minor equipment items
 - b. Control systems
 - 3. Electrical Systems, including:
 - a. Power quality
 - b. Emergency power systems
 - c. Lighting controls over the manual switches
 - 4. Electronic safety and security, including:
 - a. Fire and smoke alarms
 - 5. Communications, including:
 - a. Voice and data systems
 - 6. Other equipment and systems explicitly identified elsewhere in contract documents as required by commissioning

1.03 RELATED REQUIREMENTS

- A. Section 01 70 00 – Exclusion and close out requirements.
- B. Section 01 78 00 – Closeout Submittals: Scope and procedures for operational and maintenance manuals and project record documents.

- C. Section 01 79 00 – Demonstration and Training: Scope and procedure for Owner personal training.

1.04 REFERENCE STANDARDS

- A. PECE (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; Portland Energy Conservation, Inc.; located at <http://www.peci.org/library/mcpgs.htm>; current edition.

1.05 SUBITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect/Engineer; in that case, submit to Architect/Engineer first.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word preferred.
 - 5. As soon as possible after submittals made to Architect/Engineer are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- C. Product Data: If submittals to Architect/Engineer do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.
 - 2. Manufacturer's installation instructions.
 - 3. Startup, operating, and troubleshooting procedures.
 - 4. Fan and pump curves.
 - 5. Factory test reports.
 - 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5-degree F and resolution of plus/minus 0.1-degree F.
 - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 - 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 - EXECUTION

3.01 COMISSIONING PLAN

- A. Commissioning Authority has prepared the Commissioning Plan.
 - 1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 - 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Basis of Design Documentation (BOD): Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.
 - 1. Basis of Design Documentation is to be prepared by Architect/Engineer.
- E. Commissioning Schedule:
 - 1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 - 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 - 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
 - 1. No sampling of identical or near-identical items is allowed.
 - 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 - 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.
 - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
 - 4. Samples of Prefunctional Checklist forms that indicate anticipated level of detail can be found at <http://www.peci.org/library/mcpgs.htm>.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
 - 1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
 - 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
 - 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 - 4. If any Checklist line item is not relevant, record reasons on the form.
 - 5. Contractor may independently perform startup inspections and/or tests, at his option.

6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
 1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.

3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
 4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
 5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:
1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
 2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
 3. Samples of Functional Test forms that indicate anticipated level of detail can be found at <http://www.peci.org/library/mcpgs.htm>.
- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

- C. All Sensors:
 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2-degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
 1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
 1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
 1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg.
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

- H. Valve/Damper Stroke Setup and Check:
 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
 1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
 1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example, apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
 - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 - 2. Other points will be monitored by the Commissioning Authority using dataloggers.
 - 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
 - 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
 - 5. Graphical output is desirable and is required for all output if the system can produce it.
 - 6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 for additional requirements.
- B. Add design intent documentation furnished by Architect/Engineer to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 02 41 16

STRUCTURE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Work of this Section Includes:
 - 1. Demolition and removal of buildings or structures.
 - 2. Demolition and removal of site improvements.
 - 3. Abandoning in-place below-grade construction.
 - 4. Removing below-grade construction.
 - 5. Disconnecting, capping or sealing, and abandoning in-place site utilities.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 "Summary of Work" for use of the premises and phasing requirements.
- B. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade site improvements that are not part of building demolition.

1.3 DEFINITIONS

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

1.4 MATERIALS OWNERSHIP

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

1.5 PREINSTALLATION MEETINGS

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

7. Review storage, protection, and accounting for items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Survey of Existing Conditions: Submit survey.
- D. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.
- E. Schedule of Building Demolition Activities: Indicate the following:
 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 2. Coordination for shutoff and capping of utility services.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

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

1.9 FIELD CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials:
 1. The presence of hazardous materials in buildings and structures to be demolished has not been determined. A report on the presence of hazardous materials will be provided by the Owner prior to the start of demolition. Examine report to become aware of locations where hazardous materials are present.

- a. Hazardous material remediation will be specified in the report.
 - b. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified in the report.
 - c. Owner will provide material safety data sheets for hazardous materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.
- E. On-site sale of removed items or materials is not permitted.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 31 20 00 "Earth Moving."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged. Photograph or video conditions that might be misconstrued as damage caused by removal.
 - 2. Photograph or video existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations or removal of items for salvage.

3.2 PREPARATION

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

- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Existing Utilities to Remain: Maintain utility services to remain and protect against damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- E. Existing Utilities to Be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If disconnection of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. Cut off pipe or conduit a minimum of 24 inches below grade at or outside the building or structure to be demolished and cap, valve, or plug and seal remaining portion of pipe or conduit in accordance with requirements of authorities having jurisdiction.
 - 4. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing by authorities having jurisdiction.
- F. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 SALVAGE

- A. Items to be removed and salvaged are indicated on Drawings.
- B. Comply with the following for salvaged items:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.4 DEMOLITION, GENERAL

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

3.5 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Below-Grade Construction:
 - 1. Demolish foundation systems and other below-grade construction.

- a. Remove below-grade construction, including basements, foundation systems, and footings, to depths required to perform all work involved in construction of the project.
- D. Existing Utilities:
 - 1. Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.

3.6 SITE RESTORATION

- A. Below-Grade Areas:
 - 1. Rough grade below-grade areas ready for further excavation or new construction.
 - 2. Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials in accordance with backfill requirements in Section 31 20 00 "Earth Moving."
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

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

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with the "Waste Management Report for Contractors" to be filed with the City of Calexico and accepted by the City Engineer.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.9 CLEANING

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

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Forms for all cast-in-place concrete indicated on the Drawings and subsequent removal of forms, except those earth forms described in this Section.

1.02 RELATED SECTIONS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 QUALITY ASSURANCE

- A. Qualifications of workmen: All workmen shall be experienced mechanics. Provide one person who shall be present at all time during execution of this portion of the work who shall be thoroughly familiar with the type of material being installed, the referenced standards and the requirement of this Work and shall direct all Work performed under this Section.
- B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Recommended Practice for Concrete Formwork," publication ACI 347R and ACI 318, Section 6.1.
- C. Where provisions of pertinent codes and standards conflict with the requirement of this Section, the more stringent provision shall govern.
- D. All Structural Concrete foundations, curbs, floors and any other structural component requiring structural forming or shoring shall be Engineer Designed Systems with calculations and erection drawings provided by the Contractor. Contractor is to secure the services of a California Registered Structural Engineer for the design of Forming Systems.

1.04 PRODUCT HANDLING

- A. Protection: Contractor is to protect all formwork materials before, during and after installation.
- B. Damaged Forms: In the event of damage or misalignment, immediately make all repairs and replacement necessary at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Form lumber: All form lumber shall be new except as allowed for re-use of forms in Part 3 of this Specification, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the Architect.
 - 1. Plywood forms may be Plyform, Plyron, and bearing the label of the Douglas Fir Plywood Association.
 - 2. Form-lumber may be; fir, larch, hemlock, or approved equal seasoned lumber and surfaced on all four sides.
 - 3. Form sealers shall be liquid form oil.

- B. Not used.
- C. Other form materials and/or forming systems may be used if approved by the Owner, Architect and Structural Engineer. A complete list of materials, manufacturers and methods of application are to be submitted to the Architect, in accordance with Division 01.

2.02 TIES AND SPREADERS

- A. Form ties shall be of proven types and shall be a type which does not leave an open hole through the concrete and which permits patching at every hole.
- B. When forms are removed, all metal ties shall be removed and shall be flush with the concrete surface. No metal ties shall be exposed on the exterior of the walls.

2.03 ALTERNATE FORMING SYSTEMS

- A. Not used.

2.04 OTHER MATERIALS

- A. All other form materials, not specifically described herein, but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to approval by the Owner or Architect.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor shall verify and be responsible for all-existing dimensions and elevations before any Work is done.
- B. Inspect the installed Work of all other trades; verify that all such Work is complete, and that the installation of Formwork may begin.
- C. Verify that forms have been constructed in accordance with all pertinent codes and regulations, referenced standards and the design.
- D. Discrepancies: Do not proceed with installation in areas of discrepancy. Notify the Architect of all discrepancies. All discrepancies are to be fully resolved before proceeding with installation.

3.02 CONSTRUCTION FORMS

- A. Forms are to be constructed sufficiently tight to prevent leakage of concrete, and able to withstand excessive deflection when filled with wet concrete. Forms shall be braced, anchored and properly aligned.
- B. Layout and form all required cast-in-place concrete to the required dimensions indicated on the Drawings.
- C. Care shall be exercised in the layout of forms to avoid the necessity for cutting, patching, or repair of concrete after it is in place.
- D. Make provisions for all openings, offsets, recesses, anchorage, blocking and other requirements of the Work.
- E. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installations.
- F. Carefully examine the Drawing and Specifications and verify with other trades for openings, reglets, chases, and other items that are required in the forms.

- G. Forms for pre-cast concrete shall be constructed to provide for shrinkage of the concrete, and shall be adequately braced. All edges shall have chamfer strips except as noted on Drawings.
- H. Construct all forms true, plumb, and square within a tolerance of 1/8" in 12 feet.

3.03 EMBEDDED ITEMS

- A. Provide, install and check all required steel frames, angles, grilles, bolts, inserts and other such items required to be anchored in the forms before the concrete is placed.

3.04 BRACING

- A. Properly brace and tie the forms together so as to maintain size, shape, and alignment, and to provide safety to personnel.
- B. Construct all bracing and supporting members of ample size and strength to safely support, without excessive deflection, all dead and live loads to which they may be subjected.

3.05 PLYWOOD FORMS

- A. Plywood forms shall be designed for loads imposed. Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
- B. Make all panel joints tight butt joints with all edges true and square, if necessary, use tape to prevent excessive leakage.

3.06 FOOTING FORMS

- A. Foundation forms are to be wood forms.
- B. Earth forms may be used for footings provided the soil will stand without caving, as determined by the Architect (Structural Engineer) and the sides of the bank are made with a neat cut to the minimum dimensions indicated.

3.07 REUSE OF FORMS

- A. Reuse of forms shall be subject to approval of the I.O.R.
- B. Reuse of forms shall not delay or change the schedule for placement of concrete from the schedule if all forms were new.
- C. Reuse of forms shall not affect the structural stability of the forms or the appearance of the finished concrete.

3.08 REMOVAL OF FORMS

- A. Side forms of foundations may be removed 48 hours after placement of concrete. Where foundations are supporting lateral loads, forms shall not be removed until approved by the I.O.R.
- B. Use care and diligence, and protect workmen, passers-by, and the installed work and materials of other trades. Forms shall not be removed until the concrete can support all loads.
- C. Cut nails, tie wires and form ties off flush, leave all surfaces smooth and clean.
- D. Remove metal spreader ties and fill in the resulting pockets to match the surrounding areas with grout or dry pack. Sack all exposed faces.
- E. Fill all holes resulting from the use of bolts, ties, spreaders and sleeve nuts with cement grout applied under pressure by means of a grouting gun; grout shall be one part Portland cement, to two parts sand; apply grout immediately after removing forms.

3.09 CLEANING

- A. Remove all forming material from the site and dispose of in approved dumps.
- B. Clean area of all left over debris including stakes, ties, form boards, wires, concrete spills, etc., and leave area in a neat clean condition.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete steel reinforcement as indicated.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.

1.02 SYSTEM DESCRIPTION

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

1.03 SUBMITTALS

- A. Shop Drawings: Submit steel reinforcement Shop Drawings in accordance with ACI 315. Include assembly diagrams, bending charts and slab plans. Indicate lengths and location of splices, size and lengths of reinforcing steel.
- B. Closeout Submittals: Record exact locations of reinforcing that vary from Shop Drawings.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
 - 2. American Welding Society (AWS).
 - 3. American Concrete Institute (ACI).
 - 4. CBC, Chapter 19, Concrete.
- B. Source Quality Control: Refer to Division 01 Sections for general requirements and to following paragraphs for specific procedures. Testing laboratory retained by the Owner shall perform following conformance testing, select test Samples of bars, ties, and stirrups from the material at the Project site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A 615.
 - 1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.
 - 2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained, perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.
- C. Certification of Welders: Shop and Project site welding shall be performed by certified welding operators.

1.05 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.01 GENERAL

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

2.02 MATERIALS

- A. Steel Reinforcing Bars: ASTM A 615 and A 706 for welding, grade 60 billet steel unless otherwise specified or indicated.
- B. Bars or Rod Mats: ASTM A 184.
- C. Wire Fabric for Reinforcement: ASTM A 185.
- D. Tie Wire: ASTM A 82, fully annealed, copper-bearing steel wire, 16 gage minimum.
- E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI-315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.03 FABRICATION OF REINFORCING BARS

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.
- C. Welding: Provide only ASTM A 706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings. Before installation, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.

- B. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.
- C. Provide metal chairs to hold reinforcement the required distance above form bottoms. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.
- D. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustation's while they are still soft.
- E. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.
- F. Use deformed bars unless otherwise indicated, except for spiral reinforcement.

3.02 CLEAN UP

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

3.03 PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Forms for all cast-in-place concrete indicated on the Drawings and subsequent removal of forms, except those earth forms described in this Section.

1.02 RELATED SECTIONS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 QUALITY ASSURANCE

- A. Qualifications of workmen: All workmen shall be experienced mechanics. Provide one person who shall be present at all time during execution of this portion of the work who shall be thoroughly familiar with the type of material being installed, the referenced standards and the requirement of this Work and shall direct all Work performed under this Section.
- B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Recommended Practice for Concrete Formwork," publication ACI 347R and ACI 318, Section 6.1.
- C. Where provisions of pertinent codes and standards conflict with the requirement of this Section, the more stringent provision shall govern.
- D. All Structural Concrete foundations, curbs, floors and any other structural component requiring structural forming or shoring shall be Engineer Designed Systems with

calculations and erection drawings provided by the Contractor. Contractor is to secure the services of a California Registered Structural Engineer for the design of Forming Systems.

1.04 PRODUCT HANDLING

- A. Protection: Contractor is to protect all formwork materials before, during and after installation.
- B. Damaged Forms: In the event of damage or misalignment, immediately make all repairs and replacement necessary at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Form lumber: All form lumber shall be new except as allowed for re-use of forms in Part 3 of this Specification, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the Architect.
 - 1. Plywood forms may be Plyform, Plyron, and bearing the label of the Douglas Fir Plywood Association.
 - 2. Form-lumber may be; fir, larch, hemlock, or approved equal seasoned lumber and surfaced on all four sides.
 - 3. Form sealers shall be liquid form oil.
- B. Not used.
- C. Other form materials and/or forming systems may be used if approved by the Owner, Architect and Structural Engineer. A complete list of materials, manufacturers and methods of application are to be submitted to the Architect, in accordance with Division 01.

2.02 TIES AND SPREADERS

- A. Form ties shall be of proven types and shall be a type which does not leave an open hole through the concrete and which permits patching at every hole.
- B. When forms are removed, all metal ties shall be removed and shall be flush with the concrete surface. No metal ties shall be exposed on the exterior of the walls.

2.03 ALTERNATE FORMING SYSTEMS

- A. Not used.

2.04 OTHER MATERIALS

- A. All other form materials, not specifically described herein, but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to approval by the Owner or Architect.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor shall verify and be responsible for all-existing dimensions and elevations before any Work is done.
- B. Inspect the installed Work of all other trades; verify that all such Work is complete, and that the installation of Formwork may begin.

- C. Verify that forms have been constructed in accordance with all pertinent codes and regulations, referenced standards and the design.
- D. Discrepancies: Do not proceed with installation in areas of discrepancy. Notify the Architect of all discrepancies. All discrepancies are to be fully resolved before proceeding with installation.

3.02 CONSTRUCTION FORMS

- A. Forms are to be constructed sufficiently tight to prevent leakage of concrete, and able to withstand excessive deflection when filled with wet concrete. Forms shall be braced, anchored and properly aligned.
- B. Layout and form all required cast-in-place concrete to the required dimensions indicated on the Drawings.
- C. Care shall be exercised in the layout of forms to avoid the necessity for cutting, patching, or repair of concrete after it is in place.
- D. Make provisions for all openings, offsets, recesses, anchorage, blocking and other requirements of the Work.
- E. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installations.
- F. Carefully examine the Drawing and Specifications and verify with other trades for openings, reglets, chases, and other items that are required in the forms.
- G. Forms for pre-cast concrete shall be constructed to provide for shrinkage of the concrete, and shall be adequately braced. All edges shall have chamfer strips except as noted on Drawings.
- H. Construct all forms true, plumb, and square within a tolerance of 1/8" in 12 feet.

3.03 EMBEDDED ITEMS

- A. Provide, install and check all required steel frames, angles, grilles, bolts, inserts and other such items required to be anchored in the forms before the concrete is placed.

3.04 BRACING

- A. Properly brace and tie the forms together so as to maintain size, shape, and alignment, and to provide safety to personnel.
- B. Construct all bracing and supporting members of ample size and strength to safely support, without excessive deflection, all dead and live loads to which they may be subjected.

3.05 PLYWOOD FORMS

- A. Plywood forms shall be designed for loads imposed. Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
- B. Make all panel joints tight butt joints with all edges true and square, if necessary, use tape to prevent excessive leakage.

3.06 FOOTING FORMS

- A. Foundation forms are to be wood forms.
- B. Earth forms may be used for footings provided the soil will stand without caving, as determined by the Architect (Structural Engineer) and the sides of the bank are made with a neat cut to the minimum dimensions indicated.

3.07 REUSE OF FORMS

- A. Reuse of forms shall be subject to approval of the I.O.R.
- B. Reuse of forms shall not delay or change the schedule for placement of concrete from the schedule if all forms were new.
- C. Reuse of forms shall not affect the structural stability of the forms or the appearance of the finished concrete.

3.08 REMOVAL OF FORMS

- A. Side forms of foundations may be removed 48 hours after placement of concrete. Where foundations are supporting lateral loads, forms shall not be removed until approved by the I.O.R.
- B. Use care and diligence, and protect workmen, passers-by, and the installed work and materials of other trades. Forms shall not be removed until the concrete can support all loads.
- C. Cut nails, tie wires and form ties off flush, leave all surfaces smooth and clean.
- D. Remove metal spreader ties and fill in the resulting pockets to match the surrounding areas with grout or dry pack. Sack all exposed faces.
- E. Fill all holes resulting from the use of bolts, ties, spreaders and sleeve nuts with cement grout applied under pressure by means of a grouting gun; grout shall be one part Portland cement, to two parts sand; apply grout immediately after removing forms.

3.09 CLEANING

- A. Remove all forming material from the site and dispose of in approved dumps.
- B. Clean area of all left over debris including stakes, ties, form boards, wires, concrete spills, etc., and leave area in a neat clean condition.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete placement and finishing.
 - 2. Related Sections:
 - a. Section 03 10 00 - Concrete Forming and Accessories.
 - b. Section 03 20 00 - Concrete Reinforcing.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.
- B. Product Data:
 - 1. Mix Design: Submit a concrete mix design for each mix that will be provided for the Work. Include water/ cement ratio, size of coarse aggregate and amount of any admixture. Predict minimum compressive strength, maximum slump and air content percentage.
 - 2. Manufacturer of ready-mixed concrete shall deliver to the SPECIAL INSPECTOR a certificate with each mixer truck. Certificate shall bear the signature of representative of the testing laboratory, and shall state quantity of cement, water, fine and coarse aggregate and admixtures.
- C. Material Samples: Submit Samples illustrating concrete finishes, minimum 12 inches x 12 inches in size.
- D. Certificates: Submit a notarized certificate that each of following conforms to standards indicated:
 - 1. Aggregates - ASTM Standards C33
 - 2. Admixtures - ASTM Standards C260
 - 3. Curing materials - ASTM Standards C171

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement.
- B. American Concrete Institute (ACI) Publication:
 - 1. ACI 211 - Recommended Practice for Selecting Proportions of Concrete.
 - 2. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
 - 3. ACI 305 - Recommended Practice for Hot Weather Concreting.
 - 4. ACI 306 - Recommended Practice for Cold Weather Concreting.
 - 5. ACI 308 - Recommended Practice for Curing Concrete.
 - 6. ACI 309 - Recommended Practice for Consolidation of Concrete.
- C. American Society for Testing and Materials (ASTM) Standards:

1. ASTM A 185 - Welded Steel Wire Fabric For Concrete Reinforcement.
 2. ASTM C 31 - Making and Curing Concrete Test Specimens in the Field.
 3. ASTM C 33 - Concrete Aggregates.
 4. ASTM C 39 - Compressive Strength of Cylindrical Concrete Specimens.
 5. ASTM C 88 - Soundness of Aggregates by use of Sulphate or Magnesium Sulphate.
 6. ASTM C 94 - Ready-Mixed Concrete.
 7. ASTM C 143 - Slump of Hydraulic Cement Concrete.
 8. ASTM C 150 - Portland Cement.
 9. ASTM C 171 - Sheet Materials for Curing Concrete.
 10. ASTM C 172 - Sampling Freshly Mixed Concrete.
 11. ASTM C 173 - Air Content of Freshly Mixed Concrete by the Volumetric Method.
 12. ASTM C 227 - Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
 13. ASTM C 231 - Air Content of Freshly Mixed Concrete by the Pressure Method.
 14. ASTM C 260 - Air-Entraining Admixtures for Concrete.
 15. ASTM C 289 - Potential Reactivity of Aggregates (Chemical Method).
 16. ASTM D 1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- D. Not used.
- E. Inspection shall be performed by a representative of a testing laboratory selected by the Owner. Owner will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.
- F. Not used.
- G. Strength Test of Concrete: Refer to Section 01 45 33 - Code-Required Special Inspections.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Mixing and Placing Concrete: Refer to Section 01 45 33 - Code-Required Special Inspections.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 2. Each batch of concrete delivered to the Project site shall be accompanied by a time slip bearing departure time and signature of batch plant supervisor. Concrete shall be placed within 90 minutes after start of mixing.
- C. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.

1.05 JOB CONDITIONS

- A. Cold Weather Requirements:
 1. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Surfaces, in which concrete is to

come in contact with, shall be free from frost or ice. No frozen materials or materials containing ice shall be furnished.

2. When placing concrete during freezing or near-freezing weather the mix shall have a temperature of at least 50 degrees F., but not more than 90 degrees F. when cement is added. Concrete shall be maintained at a temperature of at least 50 degrees F. for at least 72 hours after placing or until it has thoroughly hydrated. When necessary, concrete materials shall be heated before mixing. Special precautions shall be provided for protection of transit-mixed concrete.

B. Hot Weather Requirements:

1. During hot weather, proper attention shall be provided for ingredients, production methods, handling, placing, protection and curing, to prevent excessive concrete temperatures or water evaporation which could impair required strength or durability.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of CBC Chapter 1905A.
- B. Strength of Concrete: Concrete, unless otherwise indicated or specified, shall be provided with a minimum ultimate 28-day strength of 3000 psi (f'c). For high-early-strength concrete, age for reaching the f'c shall be as indicated on Drawings.

2.02 MATERIALS

- A. Cement: ASTM C 150 Type II Portland Cement. Furnished cement shall be as selected and reviewed for concrete proportioning.
- B. Aggregates: Aggregates shall conform to ASTM C 33 and C 227 except as modified herein. Any suitable individual grading of coarse aggregate may be furnished, provided Grading of Combined Aggregate indicated in following table is obtained. Refer to Section 01 45 23: Testing and Inspection.

GRADING OF COMBINED
AGGREGATE

Sieve Number or Size in inches	1-1/2" Maximum	1" Maximum	3/4" Maximum
Passing a 2"	-----	-----	-----
Passing a 1-1/2"	95-100	-----	-----
Passing a 1"	70-90	90-100	-----
Passing a 3/4"	50-80	70-95	90-100
Passing a 3/8"	40-60	45-70	55-75
Passing a No. 4	35-55	35-55	40-60
Passing a No. 8	25-40	27-45	30-46
Passing a No. 16	16-34	20-38	23-40
Passing a No. 30	12-25	12-27	13-28
Passing a No. 50	2-12	5-15	5-15
Passing a No. 100	0-3	0-5	0-5

- C. Water: Water shall be potable and free from deleterious matter.
- D. Admixtures:
 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
- E. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D 1751.
- F. Curing Paper and Liquid Curing Compounds:
1. Curing Paper: A standard brand conforming to ASTM C 171, Type 1 - Regular, Kure-N-Seal.
 2. Liquid Curing Compounds: A standard brand, clear liquid conforming to ASTM C 309, Master Builders, Grace, Antihydro.
- G. Abrasive Aggregate: Norton Alundum, Union Carbide Carborundum, or equal, graded #12 through #30 sizes, color as selected by Architect.
- H. Underlayment: Latex underlayment for filling low spots in concrete shall be Tile-Tex by Flintkote Co., Webtex #60 or Fixallatex by Dowman Products Co.
- I. Vapor Retarder: See Section 07 26 16 - Under-Slab Vapor Retarder.
- J. Stair Strips and Nosing:
1. Fabricated from 6063-T5 extruded aluminum, mill finish. Anti-slip filler shall contain at least 60 percent virgin grain aluminum oxide abrasive. Binder shall be fully cured resilient type epoxy, with binder-to-filler ratio of 13 percent. The epoxy-abrasive filler shall extend over the curved front edge of the nosing and shall be securely bonded to the extruded aluminum base.
 2. Manufactured by Wooster Products Inc. American Safety Tread Co. Inc., or equal.
 3. Nosing and strips for concrete casting shall be provided with Sure-Hold anchors, chevron shaped continuous full length of nosing or strip.
 4. Nosings and anchors for attachment to hydrated concrete stairs and wood stairs shall be similar to those specified below, except they shall be provided with countersunk holes for screws and fasteners.
 5. Colors: As selected by Architect to contrast with stair color. Colors shall extend uniformly through the filler.
 6. Strip and Nosing Types:
 - a. Nosings for sloped riser steel pan stairs: Type WP4J, 4-1/16 inches wide, 3/8 inch thick.
 - b. Nosings for new concrete stairs: Type WP4C, 4-1/16 inches wide, 3/8 inch thick, nose projects down 1/4 inch.
 - c. Nosings for square edged steel pan stairs: Type WP4SP, 4-1/16 inches wide, 3/8 inch thick nose.
 - d. Strips for recessing into concrete stairs: Type WP1A, except 2-1/4 inches wide, 3/8 inch thick. American Safety Tread Co., Type 24, or equal.

- e. Strips for adhering to existing or hydrated concrete: Flex-Tred anti-safety strips, minimum 2-1/4 inches wide. Cut from rolls and round corners.
- f. Strips for anchoring into wood or stone: American Safety Tread Co., Type 24H, or equal, with holes for fasteners, 2-1/4 inches wide.

PART 3 - EXECUTION

3.01 GENERAL

- A. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the SPECIAL INSPECTOR at least 24 hours before placing concrete; do not place concrete until inspected by the SPECIAL INSPECTOR.
- B. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the Architect and AUTHORITIES HAVING JURISDICTION.

3.02 PREPARATION

- A. Vapor Retarder: See Section 07 26 16 - Under-Slab Vapor Retarder.
- B. Reglets and Rebates:
 - 1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
 - 2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.
- C. Not used.
- D. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

3.03 INSTALLATION

- A. Conveying and Placing:
 - 1. Notify Architect and testing and inspection agencies a minimum of 24 hours prior to commencement of concrete placement.
 - 2. Concrete shall be conveyed from mixer to location of final placement by methods, which will prevent separation or loss of materials.
 - 3. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete which has been remixed after initial set be placed.
 - 4. In placing concrete in thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.

5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
 6. Concrete shall be thoroughly consolidated during placement, and shall be worked around reinforcement and embedded fixtures with mechanical vibrators.
 7. Where conditions make consolidation difficult, or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.
- B. Compaction and Screeding:
1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.
 2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.
- C. Floating and Troweling:
1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.
 2. For interior finish slabs, final troweling shall provide a hard, impervious, and non-slip surfaces, free from defects and blemishes. Finished surface shall be within a tolerance of 1/8 inch in 10 feet. Avoid burnishing. Do not add cement or sand to absorb excess moisture.
 3. Exterior Paving and Cement Walks: Finish as specified above, except surface shall be given a non-slip broom finish to match Sample reviewed by the Architect.
 4. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.
- D. Curing:
1. Concrete shall be maintained above 50 degrees F., and in a moist condition for 7 days after placing, except that high early strength concrete shall be maintained in a moist condition for 3 days.
 2. Before applying curing paper, interior floor treated with colored hardener shall be given a heavy protective coat of colored wax left unpolished, and then immediately covered with paper. If wax is not applied within two hours after final troweling, concrete shall be sprayed with a fine water mist and maintained continuously moist until wax is applied, unless spraying is not recommended by hardener manufacturer. After other Work such as plastering and painting has been completed, curing paper shall be removed and waxed floors cleaned of protective wax coating.
 3. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.
 4. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and

continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.

5. Immediately after finishing, roof slabs and monolithic floor finish to receive resilient floor covering shall be uniformly and completely coated with liquid curing compound.
 - a. Install compound in a manner and quantity sufficient to produce a uniform continuous thin film of water-impervious membrane. Compound shall be installed in accordance with manufacturer's directions.
 - b. Protect adjoining surfaces from damage during installation. If curing compound is not applied immediately, cover finished concrete with wet burlap or curing paper and keep concrete surface wet for a period not to exceed thirty hours following finishing of concrete. At end of that time, burlap or paper shall be removed and curing compound installed as specified above.
 - c. Immediately after finishing, monolithic floor slabs not scheduled to receive resilient floor covering shall be covered with curing paper. Paper shall be lapped 3 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.
 - d. Within 24 hours after finishing, exterior slabs and paving, and interior slabs to receive cement topping or mortar setting beds, shall be covered with sand to a depth of 2 inches and kept thoroughly wet for 7 days.
 - 1) Instead of sand covering, exterior walks and paving where no other surface treatment is specified, may be cured with clear liquid curing compound immediately installed in accordance with manufacturer's directions.

E. Filling, Leveling and Patching:

1. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.
2. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.

F. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.04 FINISHING

- A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.
- B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.
 1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete

- sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.
2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.
- C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand-blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.
- D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish. Abrasive grains in amount of 30 pounds per 100 square feet shall be evenly installed by dust-on method and embedded into surface during first troweling operation. Additional abrasive grains, in amount of 30 pounds per 100 square feet, shall then be evenly installed and embedded into surface during final troweling operation.
- E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener, as specified. Install hardener after surface of concrete has reached the point where no excess moisture is present, but while it is still plastic. Hardener shall be installed as follows:
1. Colored Hardener: Install at rate of 40 pounds per 100 square feet of surface for initial application.
 2. Gray (natural) Hardener: Install at rate of 20 pounds per 100 square feet of surface for initial application.
 3. Hardener shall be evenly distributed and thoroughly floated into surface mortar with a wood float. An additional 20 pounds of hardener, colored or gray, specified as above, shall be installed over each 100 square feet, and troweled to an even surface having uniform color and texture.
- F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.
- G. Broom Finish: Exterior stair treads and landings shall be provided with a non-slip broom finish in addition to abrasive finish specified.
- H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturer's written recommendations.

3.05 EXPANSION AND CONSTRUCTION JOINTS

- A. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:
1. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
 2. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least

one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.

3. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.
- B. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab. Joint filler shall be 3/8 inch thick, unless otherwise indicated.
- C. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

3.06 TESTING

- A. Molded Cylinder Tests:
 1. Owner Consultant will prepare cylinders. Each cylinder shall be dated, given a number, point in structure from which sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.
 2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of 3 days, 7 days, and 28 days. A strength test shall be the average of the compressive strength of 2 cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'c.
 3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C 31, and tested in accordance with ASTM C 39.
- B. Core Test: At request of the Architect, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC and ASTM C 42.
 1. Provide 4 inch diameter cores at representative places throughout the structure as designated by the Architect.
 2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.
 3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.
- C. Concrete Consistency: Measure consistency according to ASTM C 143. Test twice each day or partial day's run of the mixer.
- D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, fall below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.
- E. Defective Concrete:
 1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the Architect and SEOR.
 2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to

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

- F. Concrete for Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall be 3,000 psi concrete. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 30 10 00: Concrete Forms and Accessories, and reinforced as described in Section 03 20 00: Concrete Reinforcement. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4 inch to 1 inch aggregate as specified for concrete mix.

3.07 CLEAN UP

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

3.08 PROTECTION

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

END OF SECTION

SECTION 03 35 16.13

CONCRETE FLOOR SEALING-HARDENING-DENSIFYING COMPOUNDS

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 clear, sealing-hardening-densifying compounds for horizontal traffic bearing, cured concrete surfaces.
 - 1. Contractor's Discretion: Compound may be applied to fresh concrete as a curing agent if such application is approved in writing by compound manufacturer.
- B. Related Sections include the following:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for curing compounds.
 - 2. Section 07 92 00 "Joint Sealants."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Confirm locations of surfaces receiving sealing-hardening-densifying compound.
 - 2. Confirm if compound is to be applied to fresh or cured concrete.
 - 3. If applied in locations receiving joints sealants, confirm that joint sealant adhesion and compatibility with compound has been verified.

1.4 ACTION SUBMITTALS

- A. Product Data: For sealing-hardening-densifying compound.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by compound product manufacturer.

1.7 PROJECT CONDITIONS

- A. Protect concrete surfaces receiving sealing-hardening-densifying compounds in a manner acceptable compound manufacturer and applicator, that ensures that surface of concrete is maintained in condition without damage, deterioration, discoloring, or other surface imperfections that would impair aesthetic effect of final finish.
- B. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit compounds to be applied according to manufacturers' written instructions:
 - 1. Ambient temperature is above 40 deg F.

ICTC Callexico Intermodal Transit Center

CONCRETE FLOOR SEALING-HARDENING-
DENSIFYING COMPOUNDS

IFB Deliverable

03 35 16.13 - 1
02/01/24

2. Rain or snow is not predicted within 24 hours.
3. Application proceeds more than 24 hours after surfaces have been wet.
4. Substrate is not frozen, or surface temperature is above 40 deg F.
5. Windy conditions do not exist that may cause sealing-hardening-densifying compound to be blown onto vegetation or surfaces not intended to be treated.

PART 2 - PRODUCTS

2.1 SEALING-HARDENING-DENSIFYING COMPOUNDS

- A. Compound: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces. Comply with the following:
 1. Compounds applied to fresh concrete as a curing agent:
 - a. Shall contain no silicones or components that produce silicone resins.
 - b. Shall not be applied to concrete containing Type K shrinkage compensating cement or shrinkage reducing admixtures with hydrophobic properties.
 2. Wear Index per ASTM D 4060: Not greater than 0.6 when 500 cycles of abrasion with abrasive wheel number C-18 are recorded on coated concrete surface.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 1. BASF Corporation; MasterKure HD 200WB or MasterKure HD300 WB.
 2. ChemMasters, Inc; Chemisil Plus.
 3. ChemTec International; ChemTec One.
 4. Curecrete Distribution Inc.; Ashford Formula.
 5. Dayton Superior; Pentra-Hard Densifier or Sure Hard Densifier J17.
 6. Euclid Chemical Company (The); an RPM company; Euco Diamond Hard or Eucosil.
 7. Kaufman Products, Inc; Diamond, or SureHard, or SureHard LS.
 8. Laticrete International, Inc.; L&M Seal Hard.
 9. PROSOCO, Inc; Consolideck LS.
 10. SpecChem, LLC; LithSeal SC or SpecHard.
 11. US SPEC, Division of US MIX Company; Permalith.
 12. W.R. Meadows, Inc; Liqui-Hard or Liqui-Hard Ultra.

PART 3 - EXECUTION

3.1 PREPARATION AND APPLICATION

- A. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of compounds. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of compound being deposited on surfaces. Cover live plants and grass.

ICTC Calxico Intermodal Transit Center

CONCRETE FLOOR SEALING-HARDENING-
DENSIFYING COMPOUNDS

IFB Deliverable

03 35 16.13 - 2
02/01/24

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of compounds and to instruct Applicator on the product and application method to be used.
- C. Proceed with application only after unsatisfactory conditions have been corrected.
- D. Apply sealing-hardening-densifying compounds according to manufacturer's written instructions.
 - 1. Cured Concrete Application:
 - a. Do not apply to concrete that is less than 28 days' old unless approved otherwise by compound manufacturer in writing.
 - b. Coordination with Sealants: Do not apply compounds until sealants for joints adjacent to surfaces receiving compound have been installed and cured.
 - 1) Compound application work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, compound, and sealant materials identical to those used in the work.
 - c. Clean substrate of substances that might interfere with penetration or performance of compounds. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants.
 - d. Complete surface repairs prior to compound application.
 - e. Ensure that concrete surface is sufficiently dry; test for moisture content, according to compound manufacturer's written instructions.
 - f. Apply compound until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - g. Rinse with water; remove excess material until surface is dry.
 - h. Apply a second coat in a similar manner if surface is rough or porous.
 - 2. Fresh Concrete Application (Contractor's Discretion): Apply compound to fresh concrete only when approved in writing by manufacturer:
 - a. Apply only after concrete has received final finish.
 - b. Apply as soon as feasible after concrete has hardened sufficiently to walk on and support compound application operations.
 - c. Apply compound until surface is wetted, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - d. Rinse with water; remove excess material until surface is dry.
 - e. Apply a second coat in a similar manner if surface is rough or porous.
 - 3. Minimum Application Rate: Not less than recommended by compound manufacturer.

3.2 CLEANING

- A. Immediately clean compound from adjoining surfaces and surfaces soiled or damaged by compound application as work progresses. Repair damage caused by compound application. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 03 35 43

POLISHED CONCRETE FINISHING

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 polished concrete finishing.
 - 1. Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 03 30 00 "Cast-in-Place Concrete."

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

1.5 QUALITY ASSURANCE

- A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.
 - 1. Locate panels as indicated or, if not indicated, as directed by Owner.
 - 2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

3. Demolish and remove field sample panels when directed.

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 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. Advanced Floor Products; Retro Plate 99.
 - b. Ardex Americas; PC 50 Lithium Densifier.
 - c. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - d. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - e. QuestMark; DiamondQuest Densifying Impregnator.
 - f. Vexcon Chemicals, Inc.; Certi-Shine Clear.

PART 3 - EXECUTION

3.1 POLISHING

- A. Polish: Level 2: Low sheen, 400 grit.
- B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth .
 2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 4. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 5. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.

6. Control and dispose of waste products produced by grinding and polishing operations.
7. Neutralize and clean polished floor surfaces.

END OF SECTION

SECTION 04 22 00

CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Reinforcing steel.
 - 3. Mortar, grout and grouting.
 - 4. Bolts, anchors, hardware, metal frames, and other insert items.
- B. Related Sections:
 - 1. Section 01 45 33 - Code-Required Special Inspections.
 - 2. Section 03 10 00 - Concrete Forming and Accessories.
 - 3. Section 03 20 00 - Concrete Reinforcing.
 - 4. Section 03 30 00 - Cast-in-Place Concrete.

1.02 SUBMITTALS

- A. Mix Design: Submit grouting mix design.
- B. Product Data: Submit manufacturer's Product Data for assembly components, materials, and accessories.
- C. Samples: Submit Samples for each type of required masonry unit, including reinforcement and accessories.

1.03 QUALITY ASSURANCE

- A. Perform the Work in accordance with CBC, Chapter 21. Refer to Section 01 45 33 - Code-Required Special Inspections.
- B. Comply with requirements of TMS 602/ACI 530.1/ASCE 6.
- C. Concrete Masonry Units: Sample and test in accordance with ASTM C 140.
 - 1. Notify the testing laboratory a minimum of 45 days in advance of installing concrete unit masonry, to allow for testing of the units for compression, shrinkage, and absorption. Absorption test requires 40 days.
 - 2. The retained material testing laboratory shall receive five concrete masonry units per test from masonry unit manufacturer, as designed or specified by the Architect, and shall perform and send required test results to the Architect and SPECIAL INSPECTOR.
- D. Portland Cement: Obtain sample and test in accordance with ASTM C 150.
- E. Mortar: Obtain sample and test in accordance with ASTM C 780.
- F. Grout: Obtain sample and test in accordance with ASTM C 404.
- G. Compressive Tests: Obtain sample and test to verify compliance with the following minimum values:
 - 1. Mortar: At least 800 psi at 7 days and 1,800 psi at 28 days.
 - 2. Grout: At least 1,200 psi at 7 days and 2,000 psi at 28 days.
 - 3. Do not test 28-day specimen when 7-day tests exceed 28-day requirements.

- H. Inspection During Installation: SPECIAL INSPECTOR will continuously observe the installation of reinforced masonry.
- I. The Owner will be responsible for the costs of original tests and inspection.
- J. If core testing is required, masonry removed by coring operations shall be replaced to match adjoining Work. Core testing shall conform with CBC, Chapter 21.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store units above grade on level platforms to allow air circulation under stacked units.
- B. Cover and protect against wetting before installation.
- C. Handle units on pallets or flat bed barrows. Free discharge from conveyor units or transportation in mortar trays is not permitted.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete Unit Masonry: Modular medium weight conforming to ASTM C 90, hollow load-bearing concrete unit masonry. Units shall be provided by RCP Block & Brick, Inc. or equal.
 - 1. Provide open-end units at walls to be grouted.
 - 2. Provide closed-end units at walls and at openings where ends will be exposed in finish Work; provide bond beam blocks where horizontal reinforcing is indicated.
 - 3. Provide special shapes and accessory units at locations indicated on Drawings.
 - 4. Color and texture of masonry units shall be as indicated on the drawings.
 - 5. Masonry unit shall have been cured for a minimum of 28 days.
 - 6. Masonry unit shall have maximum linear shrinkage or 0.065 percent from saturated to oven dry.
 - 7. Concrete masonry unit sizes shall be as indicated on the drawings.
- B. Portland Cement: ASTM C 150, Type II, from one source.
- C. Mortar: ASTM C 270.
- D. Grout: ASTM C 476.
- E. Hydrated Lime: ASTM C 207, Type S.
- F. Admixture for Grout: Grout Aid Type 2, complying with CBC requirements; as manufactured by Sika Chemical Corp. Refer to Section 01 45 23: Testing and Inspection.
- G. Water: Potable and fresh.
- H. Cleaning Materials: Shure Klean No. 600 detergent by ProSoCo.
- I. Miscellaneous Materials: As required to complete the Work.
- J. Sampling and Testing of Mortar: Refer to Section 01 45 23: Testing and Inspection.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Discard units with cracked faces, chipped surfaces, or other defects not complying with requirements of ASTM C 216.

3.02 MORTAR AND GROUT MIXING

- A. Mortar: Dry, loose volumes. Mix proportions shall be verified by material testing laboratory.
 - 1. Portland Cement: 1 part.
 - 2. Hydrated lime: 1/4 to 1/2 part.
 - 3. Mortar sand: 2-1/4 to 3 parts.
 - 4. Water: to provide required consistency.
 - 5. Mixing time for Silotec Mortar System shall be in accordance with Silotec Mortar System recommendations instead of those indicated in Section 01 45 23: Testing and Inspection.
- B. Grout: Shall provide a minimum strength of 2000 psi unless noted otherwise. Grout strengths in excess of more than 2000 psi shall be verified by a material testing laboratory.
 - 1. Fine Grout: Portland Cement 1 part; sand 2 ¼ to 3 parts; water to attain a slump of 8 to 10 inches.
 - 2. Coarse Grout: Portland Cement 1 part; pea gravel 2 ¼ to 3 parts; water to attain a slump of 8 to 10 inches.
- C. Measurements: Proportion by accurate volume measurements. Measure in calibrated devices that can be checked at any time.
 - 1. Add water for workable consistency.
 - 2. Shovel measurements are not permitted.
- D. Mixing: Place sand, cement, and water in mixer in that order, while mixer is running; mix for 3 minutes, add lime, and admixture (for grout), and continue mixing until a uniform mass is provided, but in no case less than 10 minutes.
 - 1. Not used.
 - 2. Batches of less than one sack of cement, and fractional sack batches are not permitted.
- E. Re-tempering Time Limit: Re-temper on mortar boards, for at least 3 minutes, but not more than 10 minutes when required, by adding water into a basin formed by mortar, and installing mortar into it. Dashing, or pouring of water over mortar is not permitted.
 - 1. Do not re-temper mortar which has become hard or non-plastic.
 - 2. Discard mortar, which has not been installed within one hour after original mixing.
 - 3. Ready-Mix Grout: Grout batched off the Project site and delivered by mixer truck shall be subject to same procedures and controls as prescribed by building code requirements. Refer to Section 01 45 33 - Code-Required Special Inspections.

3.03 INSTALLATION OF MASONRY UNITS

- A. Workmanship: Install masonry plumb and true to line with straight level joints of uniform thickness. Maintain masonry clean during and after installation.
 - 1. Lay-out and incorporate embedded hardware items.
 - 2. Assist other trades with built-in items, which require cutting and fitting of masonry.
 - 3. Cut block units with a diamond saw or carborundum wheel. Trowel or chisel cutting is not permitted.
 - 4. Keep cavities clear of droppings and debris. Remove promptly.

- B. Reinforcing Steel: Install as indicated on Drawings. Except as otherwise indicated, install reinforcement in accordance with standards of Concrete Reinforcing Steel Institute and to requirements specified in Section 03 20 00 - Concrete Reinforcing. Do not splice vertical reinforcing except where indicated on the Drawings.
- C. Shoring: Provide temporary shoring for lintels with sufficient strength to carry load without deflecting. Remove temporary shoring 28 days after masonry has been installed.
- D. Block Installation: Clean dirt and dust from surfaces before installation. Do not wet masonry units except in very dry weather.
 - 1. Foundation preparation: Sandblast tops of concrete starting surfaces, wash-off by high pressure water jet, and slurry coat surfaces with neat cement grout for bond to masonry.
 - 2. Install masonry with mortar to required joint thickness. Install blocks with 3/8-inch mortar bed on entire horizontal surface. Fill head joints solid, install tightly to adjoining units. Provide 3/8-inch joint thickness.
 - a. Hold racking to a minimum.
 - b. No tothing is permitted.
 - c. If it becomes necessary to move a unit after it has been installed, remove the unit, discard the mortar, and install the unit in fresh mortar.
 - 3. Anchor Bolts: Provide one-inch minimum grout space around protruding bolts.
 - 4. Bond: Unless otherwise indicated, install units in common running bond.
 - 5. Finish Joint Treatment: Unless otherwise indicated, cut both interior and exterior joints flush, and tool slightly concave to a dense, uniform surface.
 - 6. Grouting: Unless noted otherwise on Drawings, completely fill cells with grout.
- E. Steel Door Frames:
 - 1. Locate doorframes accurately, install plumb, "Ram-set" or "Rawlplug" to floor surface and brace in position before start of masonry installation.
 - a. Frames are specified to be furnished with adjustable anchors.
 - b. Fill interior of frames solid with mortar or grout as walls are constructed.
 - 2. Provide temporary wood spreaders from jamb to jamb and from head to floor to ensure that jambs do not bow-in, distort from a straight line, or deflect from superimposed loads during construction.

3.04 LOW-LIFT GROUTING FOR HOLLOW MASONRY UNITS

- A. After mortar joints have set, cores are cleaned of mortar and debris, and reinforcing is installed and inspected, grout cells in 2 feet maximum lifts, providing specified pea gravel grout mix. Refer to Section 01 45 23: Testing and Inspection.
- B. Grouted walls shall be solid and without voids.
- C. Grout may be installed by pump, tremie or bucket, using hoppers to avoid spilling on exposed surfaces.
- D. Place an initial 2 feet high lift around, thoroughly compact, then place balance of each lift, compacting again through total lift, with hardwood spading sticks or pencil vibrators.
- E. Stop grout pours 1-1/2 inches below top of each lift.
- F. Remove and discard spilled grout from upper units before grout can harden.
- G. Bracing: Adequately brace walls against wind and other forces during and after construction.
- H. Re-puddle top of grout after initial set.

3.05 HIGH-LIFT GROUTING OPTION FOR HOLLOW MASONRY UNITS

- A. High-lift grouting method is permitted provided following qualifications and requirements are met. High-lift grouting shall apply only to cell sizes available with 8 inch and wider block units.
- B. Provide bond beam units, inverted for start course, and omit alternate blocks or cut openings in alternate face shell on bottom course for cleanouts.
- C. Remove projecting mortar fins. Wash out every cell thoroughly using a water jet, which has sufficient force to remove mortar from the interior of the cells, and from reinforcing steel.
- D. Plug each cleanout by setting a "soap" in mortar into opening and securely bracing it in place to prevent displacement. If masonry is not exposed in finish Work, cleanouts may be formed.
- E. Grouting:
 - 1. Grout masonry cells solid, free from voids.
 - 2. Do not install grout until masonry has set a minimum of 3 days in warm weather (50 degrees to 85 degrees F.) or 5 days in cool, damp weather (35 degrees to 50 degrees F.).
 - 3. Pump grout into grout cell space as rapidly as practical. Discard grout not in place within one hour after water was first added to batch.
 - 4. Install grout with maximum slump without segregation. Place in a continuous pour, in maximum lifts of 4 feet, with approximately 20 minutes elapsed time between any 2 successive lifts.
- F. Consolidating:
 - 1. Consolidate and reconsolidate grout using 3/4 inch lightweight flexible cable vibrators.
 - 2. First consolidation shall be performed to bottom of lift immediately after placement, and in case of subsequent lifts, through previously placed lift.
 - 3. Top lift shall be reconsolidated no sooner than 30 minutes after grout has been installed.
 - 4. Vibrating of reinforcing steel is not permitted.
- G. Bracing: Adequately brace walls against wind and other forces during and after construction.

3.06 CURING

- A. Remove efflorescence, stains, debris, excess grout, and foreign matter.
- B. During curing, or for any other purpose, do not saturate masonry with water.
- C. For low-humidity conditions, dampen the wall surface with a very light fog spray continuously for 3 days to cure mortar in joints.

3.07 PARGE COAT

- A. Apply parge coat to the earth side of surfaces that are to receive waterproofing.
- B. A Portland cement and sand mix (1:3.5 by volume), or Type M or S mortar may be used for the parge coat.
- C. Parging should be applied to damp (not saturated) concrete masonry in two 1/4" (6mm) thick layers. The first coat should be roughened when partially set, hardened for 24

hours, and then moistened before second coat is applied. The second coat should be trowelled to a smooth, dense surface.

- D. The parge coat should be beveled at the top to form a wash, and thickened at the bottom to form a cove between the base of the wall and the top of footing.

3.08 CLEANING

- A. At completion of masonry Work, remove misplaced mortar, grout or other foreign substances, and clean surfaces which will be exposed in finish Work with specified cleaner, or with clean water and stiff fiber brushes.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.09 PROTECTION

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

END OF SECTION

SECTION 04 26 13
MASONRY VENEER

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. Clay thin brick.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
- C. Samples:
 - 1. Clay face thin brick.

1.5 INFORMATIONAL SUBMITTALS

- A. 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. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
- C. Mix Designs: For each type of mortar. 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/C 91M for air content.
- D. 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. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches high by full thickness.
 - a. Include a sealant-filled joint at least 16 inches (400 mm) long in each mockup.
 - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
 - c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include studs, sheathing, water-resistive barrier, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
 - 2. Clean exposed faces of mockups with masonry cleaner as indicated.
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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. Store preblended, dry mortar mix in delivery containers on elevated platforms 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 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of veneer, 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 (600 mm) down face of veneer, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with 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.
 - 5.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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.
- B. 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.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

2.3 THIN BRICK VENEER

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view. Mechanical chopping or breaking thin brick, or bonding pieces of thin brick together by adhesive, are unacceptable procedures for fabricating special shapes.
 - a. Provide molded, thin brick shapes for applications at 90-degree and 135-degree outside corners.
- B. Clay Thin Brick:
1. Basis-of-Design Product: Subject to compliance with requirements, provide **McNear Sandmold Series** or a comparable product by one of the following:
 - a. Belden Brick Company.
 - b. Endicott Clay Products Co.
 - c. Glen-Gery Corp.
 2. Color: McNear Camden.
 3. Grade: Exterior Grade.
 4. Type: TBX.
 5. 24-Hour Cold Water Submersion Absorption: Maximum 6 percent when tested per ASTM C 67.
 6. Five-Hour Boil Absorption: Maximum 6 percent when tested per ASTM C 67.
 7. Freeze-Thaw Resistance: No detectable deterioration (spalling, cracking, or chafing) when tested in accordance with ASTM C 666/ASTM C 666M.
 8. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 9. Out of Square: Plus or minus 1/16 inch measured to nearest 1/32 inch according to ASTM C 67; passes.
 10. Warpage: Consistent plane of plus 0 inch, minus 1/16 inch measured to nearest 1/32 inch; passes.
 11. Size: Modular 2-1/4 inches high x 7-5/8 inches long, 5/8 inch thickness.

2.4 MORTAR MATERIALS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Laticrete International, Inc.; 254 Platinum thin set mortar.
- B. Thickness: 1/8 inch to 3/16 inch.
- C. Water: Potable.

2.5 GROUT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete International, Inc. PermaColor Grout** or a comparable product by one of the following:
 - 1. W.R. Meadows.
 - 2. Five Star Products.
- B. Color: As directed by Owner.
- C. Water: Potable.

2.6 ACCESSORY MATERIALS

- A. Sealant:
 - 1. General: Per TCA EJ171; for use in expansion joints, coves, corners, changes in plane and other joints where thin brick abuts dissimilar materials.
 - 2. Type: Per ASTM C920; Type S, Grade NS, Class 25, Use NT.
 - 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Laticrete International, Inc.; Latasil Silicone Sealant.

2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim".

2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
 - 2. EaCo Chem, Inc.
 - 3. PROSOCO, Inc.

2.9 MORTAR MIXES

- A. 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.
- B. Mortar for Unit Masonry: Comply with ANSI A118.4 and ANSI A118.11 requirements.
- C. Water: Potable.

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 the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. 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.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Matching Existing Masonry: Match coursing, bonding, and texture of existing masonry.
- E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. 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.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond to match existing; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
- B. Related Sections:
 - 1. Section 01 45 33 - Code-Required Special Inspections.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.
 - 3. Section 05 31 00 - Steel Decking.
 - 4. Section 05 50 00 - Metal Fabrications.
 - 5. Section 09 91 13 - Exterior Painting.
 - 6. Section 09 91 23 - Interior Painting.

1.02 REFERENCES

- A. AISC – Steel Construction Manual:
 - 1. AISC 360 Specifications for Structural Steel Buildings.
 - 2. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- AA. AISC 341 - Seismic Provisions for Structural Steel Buildings, including Supplements.
- B. AISC S323 - Quality Criteria and Inspection Standards.
- C. AISC - American Institute of Steel Construction, Code of Standard Practice for Steel Buildings and Bridges, for Architecturally Exposed Structural Steel.
- D. ASTM A36 - Structural Steel.
- E. ASTM A53 - Hot Dipped, Zinc-Coated Welded and Seamless Steel Pipe.
- F. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold-Finish, Standard Quality.
- G. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- H. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- I. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- J. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- K. ASTM A500 - Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- L. ASTM A572 - Grade 50 - Structural Steel.
- M. ASTM A653 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated by the Hot-Dip Process.
- N. ASTM A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- O. ASTM A992 - Steel for Structural Shapes For Use in Building Framing.
- P. ASTM C1107 - Packaged Dry, Hydraulic Cement Grout (Non-Shrink).
- Q. ASTM F1554 - Standard Specification for Anchor Bolts.
- R. AWS A2.4 - Standard Welding Symbols.

- S. AWS D1.1 - Structural Welding Code.
- SS. AWS D1.8 - Structural Welding Code – Seismic Supplement.
- T. AWS WHB-1 - Qualification and Certification.
- U. AWS A5.1 - Carbon Steel Covered Arc-Welding Electrodes.
- V. CBC Chapter 22
- W. SSPC - Steel Structures Painting Council, SP-2, Hand Tool Cleaning.
- X. Federal Emergency Management Agency (FEMA)
 - 1. FEMA 353 - Recommended Specification and Quality Assurance Guidelines for Steel Moment Frame Construction for Seismic Application, July 2000.

1.03 SYSTEM DESCRIPTION

- A. Regulatory Requirements:
 - 1. Structural steel shall conform to CBC requirements, except that steel manufactured by acid Bessemer process is not permitted for structural purposes.
 - 2. Sheet and strip steel other than those listed in CBC, if provided for structural purpose, shall comply with CBC requirements.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit Shop Drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar detailing as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked in stresses and distortion; submit sequence and technique plan for review by the Architect.
 - a. Include details of cuts, connections, camber, and holes in accordance with Figure 4.5 of AWS D1.1-02 or AISC Section J1.8, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.
 - b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed for Work specified in other section.
 - c. Erection and Bracing Plan and Erection Procedure: Submit an erection and framing plan, including columns, beams, and girders, prepared, signed and sealed by a structural engineer registered in the State of California in accordance with Title 8 CCR, Section 1710. Maintain a copy at the Project site as required by the California Division of Industrial Safety.
 - d. Submit a list of steel items to be galvanized.
 - 2. Product Data:
 - a. Submit copies of fabricator's specifications and installation instructions for the following products. Include laboratory test reports and other data required demonstrating compliance with these Specifications:
 - 1) Structural steel, each type; including certified copies of mill reports covering chemical and physical properties.
 - 2) Welding electrodes.
 - 3) Welding gas.
 - 4) Unfinished bolts and nuts.

- 5) Structural steel primer paint.
 - 6) High-strength bolts, including nuts and washers.
3. Manufacturer's Mill Certificate:
 - a. Submit, certifying that products meet or exceed specified requirements.
 4. Mill Test Reports:
 - a. Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.
 5. Charpy-V-Notch (CVN) Impact Test: Submit certified copies of Charpy-V-Notch (CVN) Impact Test by the manufacturer for applicable steel members and components.
 - a. Charpy-V-Notch (CVN) Impact Test for Base Metal: hot rolled shapes with flanges 1_1/2 in. thick and thicker and plates 2 in. thick and thicker shall be subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part A3.3
 - b. Not used
 - c. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A 673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E 23. The absorbed energy in a CVN impact test shall not be less than that specified in "Seismic Provisions for Structural Steel Buildings", Part A3.3
 6. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured using fully killed fine grain practice having grain size number 5 or better as determined by ASTM E 112.
 7. Weld Procedure Specifications (WPS): Submit weld procedures according to AWS D1.1 for each welded joint on project (whether prequalified or qualified by testing) to Owner's testing laboratory for approval. After approval by testing laboratory, submit to Architect for record. Weld procedures shall indicate joints details and tolerances, preheat and interpass temperature, post-heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last pass, electrode type and size, welding current, polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged, from these averages the weld heat input shall be calculated. Submit the manufacturer's product data sheet for all welding material used.
 8. Welder's Certificates: Field welders shall be Project certified in accordance with AWS D1. 1-15. Shop welders shall be Project certified for FCAWS in accordance with AWS D1. 1-15.
 9. Test Reports: Submit reports of tests conducted on shop and field welded and bolted connections. Include data on type of test conducted and test results.
 10. Welding Material Certification: Comply with AWS D1.8 Section 1.22. Submit to Owner's testing laboratory.

1.05 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement, except as otherwise indicated:
 1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges,
 2. Perform welding in accordance with AWS Standards, AWS D1.1, and California Building Code Section 1705A.2.5 and approved weld procedure.
- B. Shop fabrication shall be inspected in accordance with CBC.

- C. Erect mock-up panel of fabricated structural steel meeting Architecturally Exposed Structural Steel tolerances for exposed areas. Approval by Architect is required. Mock-up to remain for comparison but may not be left as part of the work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store structural steel above grade on platforms, skids or other supports.
- B. Protect steel from corrosion.
- C. Store welding electrodes in accordance with AWS D 12.1.
- D. Store other materials in a weather-tight and dry place until installed into the Work.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Stock Materials: Provide exact materials, sections, shapes, thickness, sizes, weights, and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered if net area of shape or section is not reduced thereby, if material and structural properties are at least equivalent, and if overall dimensions are not exceeded.

2.02 MATERIALS

- A. Structural Steel: All wide flange shapes shall conform to ASTM A992 Grade 50. Brace Frame Base Plate shall be ASTM A572 Grade 50. Other steel shall conform to ASTM A36.
- B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon bolts and nuts.
- C. High-Strength Threaded Fasteners: ASTM A325, ASTM A490 or ASTM F1852 quenched and tempered, steel bolts, nuts and washers.
- D. Primer: Lead-free metal primer, Tnemec 10-99, Rust-Oleum X-60, or equal.
- E. Steel Pipe: ASTM A53, Type E or S, Grade B.
- F. Structural Tubing:
 - 1. Hot-formed, ASTM A501.
 - 2. Cold-formed, ASTM A500, Grade B.
- G. Galvanizing: ASTM A123.
- H. Welding Electrodes: Provide electrodes recommended by manufacturer for seismic connections.
 - 1. Comply with latest AISC Seismic Provision.
- I. Shear stud connectors: ASTM A108, Grade 1015 forged steel, headed, uncoated, granular flux filled shear connector or anchor studs by Nelson Stud Welding Division of TRW, Lorain, OH, or equal.
- J. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at 7 days; of consistency suitable for application and a 30 minute working time.
- K. Threaded Rods: ASTM F1554, grade as noted per plan.

2.03 FABRICATION

- A. Cleaning and Straightening Materials: Materials being fabricated shall be thoroughly cleaned of scale and rust, and straightened before fabrication. Cleaning and straightening methods shall not damage material. After punching or fabrication of component parts of a member, twists or bends shall be removed before parts are assembled.
- B. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall perform the cutting, punching, drilling and tapping of Work so that Work of other trades will properly connect to steel Work.
- C. Milling: Compression joints depending on contact bearing shall be furnished with bearing surfaces prepared to a common plane by milling.
- D. Use of Burning Torch: Oxygen cutting of members shall be performed by machine. Gouges greater than 3/16 inch that remain from cutting shall be removed by grinding. Reentrant corners shall be shaped notch free to a radius of at least 1/2 inch. Gas cutting of holes for bolts or rivets is not permitted.
- E. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized in largest practical sizes. Fabrication includes operations of shearing, punching, bending, forming, assembling or welding. Galvanized items shall be free from projections, barbs, or icicles resulting from the galvanizing process.
- F. Welding:
 - 1. Type of steel furnished in welded structures shall provide chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the requirements of CBC Chapter 17. Conform to AWS D1.1 and D1.8, and CBC Chapter 22A.
 - 2. Materials and workmanship shall conform to the requirements specified herein and to CBC requirements, modified as follows:
 - a. No welded splices shall be permitted except those indicated on Drawings unless specifically reviewed by the Architect.
 - b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.
 - 3. Welding shall be performed in accordance with requirements of the AWS Structural Welding Code.
 - a. Welded Joint Details: comply with AISC Seismic Provisions.
 - 4. Architecturally Exposed Structural Steel: Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.
 - 5. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Shop Finish:
 - 1. Notify the SPECIAL INSPECTOR when Work is ready to receive shop prime coat. Work shall be inspected by the SPECIAL INSPECTOR before installation of primer.
 - 2. Structural steel and fittings, except galvanized items, which will be exposed when building is completed, shall receive a coat of primer.
 - 3. The primer specified shall be spray applied, filling joints and corners and covering surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils.

4. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete or high strength bolted.
- H. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- I. Fabricate Architecturally Exposed Structural Steel with exposed surfaces smooth, square, and free of surfaces blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
 2. Comply with fabrication requirements, including tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for Architecturally Exposed Structural Steel.
- J. Not used.

2.04 SHOP AND FIELD QUALITY CONTROL

- A. A special inspector, approved by AUTHORITIES HAVING JURISDICTION to inspect the Work of this section, shall inspect high-strength bolted connections. The Owner will provide a AUTHORITIES HAVING JURISDICTION approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC 2213. The SPECIAL INSPECTOR shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- B. An AWS CWI certified special inspector, approved by AUTHORITIES HAVING JURISDICTION to inspect the Work of this section, shall inspect welded connections. The Owner will provide a AUTHORITIES HAVING JURISDICTION approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC 1704.2.4. The SPECIAL INSPECTOR shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- C. The independent testing laboratory shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.
- D. Provide access to all places where structural steel Work is being fabricated or produced so required inspection and testing can be performed.
- E. The independent testing laboratory may inspect and/or test structural steel at plant before shipment; however, Architect reserves the right at any time before Final Completion to deem materials not in compliance with the specified requirements as defective Work.
- F. Correct defects in structural Work when inspections and laboratory test reports indicate noncompliance with specified requirements. Perform additional tests as may be required to reconfirm noncompliance of original Work, and as may be required to show demonstrate compliance of corrected Work.
- G. Welding: Inspect and test during fabrication and erection of structural steel assemblies as follows:
 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the Work. Record Work required and performed to correct deficiencies.
 2. Inspect welds. Welds shall be visually inspected before performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved

- non-destructive test methods. Testing shall be performed to AWS D1.1 Table 6.3 cyclically loaded non-tubular connections.
3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Repair and test defective welds.
 4. Rate of Testing: Completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.
 5. Welds, when installed in column splices, shall be tested by either ultrasonic testing or radiography.
 6. Base metal thicker than 1-1/2 inches, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities directly behind such welds. Tests shall be performed at least 48 hours after completed joint has cooled down to ambient air temperature.
 7. Any material discontinuities shall be reviewed based on the defect rating in accordance with the criteria of AWS D1.1 table 6.3 by the Architect and AUTHORITIES HAVING JURISDICTION.
 8. Other method of non-destructive testing and inspection, for example, liquid dye penetrate testing, magnetic particle inspection or radiographic inspection may be performed on weld if required.
 9. Lamellar Tearing: Lamellar-tearing resulting from welding is a crack (with ero tolerance) and shall be repaired in accordance with AWS D1.1.
 10. Lamination: The rejection criteria shall be based on ASTM A 435.
 11. Where testing reveals lamination or conditions of lamellar tearing in base metal, the steel fabricator shall submit a proposed method of repair for review by the Architect. Test repaired areas as required.
 12. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 - Qualification.
- H. Lamellar Tearing: Prior to welding plates 1 to 1-1/2 inches thick and greater and rolled shapes within the distance from 6 inches above the top of the joint to 6 inches below the bottom of the joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur, members will be reviewed by the Architect and AUTHORITIES HAVING JURISDICTION. Welding procedure specifications in sub-section 1.5G specify welding practices to minimize lamellar tearing.
- I. Prior Testing of Base Material: Test material before fabrication.
- J. Lines and levels of erected steel shall be certified by a State of California licensed surveyor as set forth in related Division 01 section.
- K. Welded studs shall be tested and inspected by the special inspector in accordance with requirements of AWS D1.1 - Stud Welding.
- L. Record Drawings: After steel has been erected, correct or revise Shop Drawings and erection diagrams to correspond with reviewed changes performed in the field.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify governing dimensions and conditions of the Work before commencing erection Work.
 - 1. Report discrepancies between drawings and field dimensions to Architect before commencing work.
 - 2. Beginning of installation means erector accepts existing conditions and surfaces underlying or adjacent to work of this section.
- B. Provide temporary shoring and bracing, and other support during performance of the Work. Remove after steel is in place and connected, and after cast-in-place concrete has reached its design strength.

3.02 ERECTION

- A. Install structural steel accurately in locations, to elevations indicated, and according to AISC specifications and CBC requirements.
- B. Clean surfaces of base plates and bearing plates.
 - 1. Install base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims; cut off flush with edge of base or bearing plate before packing with grout.
- C. Maintain erection tolerances of structural steel within AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 1. Members and components, plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. Contractor to provide adjustable connections between Architecturally Exposed Structural Steel and the structural steel frame or the masonry or concrete supports, in order to provide the erector with means for adjustment.
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Do not permit thermal cutting during erection of structural steel.
- F. Where indicated for field connections, provide standard bolts complying with ASTM A 307.
- G. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with CBC requirements.
 - 1. Allowable hole sizes: 1/16 inch larger than bolt size.
 - 2. Use friction type connection with standard hardened steel circular, square or rectangular washer under bolt nut.
 - 3. Thoroughly clean area under bolt head, nut and washer. Remove all paint, lacquer, oil or other coatings except organic zinc-rich paints in accordance with SSPC, SP-2.
 - 4. Tighten bolts by power torque wrench or hand wrench until twist-off.
- H. Contractor shall be responsible for correcting detailing and fabrication errors and for correct fitting of all members and components.

- I. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide temporary bracing, supports or connections required for complete safety of structure until final permanent connections are installed.
- J. Install column bases within a tolerance of 1/8 inch of detailed centerlines, level at proper elevations. Support bases on double nuts and solidly fill spaces under bases with dry-pack cement grout.
- K. Provide anchor bolts with templates and diagrams. Contractor shall be responsible for proper location and installation of bolts. Correct deficiencies and errors.
- L. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780.

3.03 FITTING

- A. Closely fit members, finished true to line and in precise position required to allow accurate erection and proper joining in the field.
- B. Drilling to enlarge unfair holes will not be allowed. Allow only enough drifting during assembly to bring parts into position, but not sufficient enough to enlarge holes or distort the metal. Do not heat rolled sections, unless approved by Architect.

3.04 PUNCHING AND DRILLING

- A. Punch material 1/16 inch larger than nominal diameter of bolt, wherever thickness of metal is equal to or less than the diameter of the bolt plus 1/8 inch.
- B. Drill or sub-punch and ream where metal is equal to or more than the diameter of the bolt plus 1/8 inch. Make diameter for sub-punched and sub-drilled holes 1/16 inch larger than nominal diameter of bolt.
- C. Precisely locate holes to ensure passage of bolt through assembled materials without drifting. Enlarge holes when necessary to receive bolts by reaming; flame cutting to enlarge holes is not acceptable. Structural Steel members with poorly matched holes will be rejected.

3.05 FINISHING

- A. After erection, spots or surfaces where paint has been removed, damaged, or burned off and field rivets, bolts, and other field connections not concealed in the work, shall be cleaned of dirt, oil, grease, and burned paint and furnished with a spot coat of the same primer installed during shop priming.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Install paint to exposed areas with the same material installed during shop painting. Install by brush or spray to provide a minimum dry film thickness of 1.5 mils.

3.06 FIELD QUALITY CONTROL

- A. Owner will provide a special inspector and independent testing laboratory to perform field inspections and tests and to prepare test reports.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.07 CLEAN UP

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

3.08 PROTECTION

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

3.09 HANDLING

- A. Both in shop and in the field, transport, handle and erect to prevent damage or overstressing of any component.

END OF SECTION

SECTION 05 12 13

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Architecturally exposed structural steel (AESS) of following Categories.
 - a. AESS 1: Basic elements.
 - 2. Surface preparation requirements.
 - 3. Primers and priming requirements.
- B. Section 05 12 00 "Structural Steel Framing" requirements also apply to AESS.
- C. Related Requirements:
 - 1. Section 09 91 23 "Interior Painting" for intermediate and finish coat requirements.

1.2 DEFINITIONS

- A. AESS: Architecturally exposed structural steel.
- B. Category AESS 1: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 1 and may be designated AESS 1 or Category AESS 1 in the Contract Documents.
- C. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."
- D. Dry Exposures: A location not normally subjected to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of kitchens or locker rooms.

1.3 COORDINATION

- A. Coordinate surface preparation requirements for shop-primed items.
- B. 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.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 2. Filler.
 - 3. Steel primer.
- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.

ICTC Calexico Intermodal Transit Center

ARCHITECTURALLY EXPOSED
STRUCTURAL STEEL FRAMING

IFB Deliverable

05 12 13 - 1
02/01/24

1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 3. Include embedment Drawings.
 4. Indicate orientation of mill marks and HSS seams.
 5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
 7. Indicate exposed surfaces and edges and surface preparation being used.
 8. Indicate special tolerances and erection requirements.
 9. Indicate weep holes for HSS .
 10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.
- C. Samples: Submit Samples to set quality standards for AESS.
1. Two steel plates, 3/8 by 8 by 4 inches, with long edges joined by a groove weld matching AESS Category of each type specified.
 2. Steel plate, 3/8 by 8 by 8 inches, with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches, welded to plate with a continuous fillet weld matching AESS Category of each type specified.
 3. Round steel tube or pipe, minimum 8 inches in diameter, with end of another round steel tube or pipe, approximately 4 inches in diameter, welded to its side at a 45-degree angle with a continuous fillet weld matching AESS Category of each type specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.
- B. Installer Qualifications: Installer (erector) shall comply with qualification requirements specified in Section 05 12 00 "Structural Steel."

ICTC Calexico Intermodal Transit Center

ARCHITECTURALLY EXPOSED
STRUCTURAL STEEL FRAMING

IFB Deliverable

05 12 13 - 2
02/01/24

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
 - 1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed by Owner.

1.08 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, (ASTMA563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers with following finishes:
 - 1. Plain for dry exposures.
 - 2. Mechanically deposited zinc coating for damp and wet exposures.

2.3 FILLER

- A. Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

- A. Steel Primer:
 - 1. For intermediate and topcoats specified under Section 09 91 23 "Interior Painting" comply with the following:
 - a. For High-Performance Architectural Latex System MPI INT 5.1R/RR prime coat with one of the following:
 - 1) Alkyd, quick dry, for metal, MPI #76 for 5.1R.
 - 2) Alkyd, anti-corrosive, for metal, MPI #79 for 5.1RR.

2.5 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.
- B. Category AESS 1:
1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 2. Prepare surfaces according to Part 2 "Shop Priming" Article.
 3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 4. Make intermittent welds appear continuous, using filler or additional welding.
 5. Seal weld open ends of hollow structural sections with 3/8-inch closure plates.
 6. Limit butt and plug weld projections to 1/16 inch.
 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 8. Remove weld spatter, slivers, and similar surface discontinuities.
 9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
 10. Grind tack welds smooth unless incorporated into final welds.
 11. Remove backing and runoff tabs, and grind welds smooth.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type:
 - a. As indicated on Structural Drawings.
 - b. Snug tightened where indicated on Structural Drawings.
 - c. Pretensioned where indicated on Structural Drawings.
 - d. Slip critical where indicated on Structural Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections, except as follows:
 - a. Organic, epoxy/zinc rich primer or inorganic zinc rich primer meeting class B surface requirements for slip critical connections may be used if approved by Architect.
- B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards. See Part 1 Article "Definitions" for descriptions of Dry, Damp, and Wet Exposures.
 1. Substrates at Dry Exposures: Either of following or better:
 - a. SSPC-SP 7/NACE No. 4, Brush-Off Blast Cleaning.
 - b. SSPC-SP 7 (WAB)/NACE WAB-4, Brush-Off Wet Blast Cleaning.
 - c. SSPC-SP 11, Bare Metal Power Tool Cleaning.
 - d. SSPC-SP 14/NACE 8, Industrial Blast Cleaning.
 - e. SSPC-SP 14 (WAB)/NACE WAB-8, Industrial Wet Blast Cleaning.
 - C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.

ICTC Calexico Intermodal Transit Center

ARCHITECTURALLY EXPOSED
STRUCTURAL STEEL FRAMING

IFB Deliverable

05 12 13 - 5
02/01/24

1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
 2. Grind tack welds smooth.
 3. Remove backing and runoff tabs, and grind welds smooth.
 4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 5. Conceal fabrication and erection markings from view in the completed structure.
- B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.
1. Erection of Category AESS 1:
 - a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - c. Remove weld spatter, slivers, and similar surface discontinuities.
 - d. Grind off butt and plug weld projections larger than 1/16 inch.
 - e. Continuous welds shall be of uniform size and profile.
 - f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - g. Splice members only where indicated on Drawings.
 - h. No torch cutting or field fabrication is permitted.
 - i. Remove erection bolts, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
 - j. Fill weld access holes with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type:
 - a. As indicated on Structural Drawings.
 - b. Snug tightened where indicated on Structural Drawings.
 - c. Pretensioned where indicated on Structural Drawings.
 - d. Slip critical where indicated on Structural Drawings.

ICTC Calexico Intermodal Transit Center

ARCHITECTURALLY EXPOSED
STRUCTURAL STEEL FRAMING

IFB Deliverable

05 12 13 - 6
02/01/24

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.5 PROTECTION

- A. Touchup Priming: 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. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal decking.
 - 2. Shear connectors.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 45 33 - Code-Required Special Inspections.
 - 3. Section 05 12 00 - Structural Steel Framing.

1.02 REFERENCES

- A. AISI - Specifications for the Design of Cold-Formed Steel Structural Members.
- B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- C. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- E. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
- F. AWS D1.3 - Structural Welding Code Sheet - Steel.

1.03 PERFORMANCE REQUIREMENTS

- A. Compute properties of deck sections on basis of effective design width as limited by provisions of the AISI specifications. Provide no less than deck section properties specified, including section modulus and moment of inertia per foot of width.
- B. Regulatory Requirements:
 - 1. Requirements of Regulatory Agencies: AUTHORITIES HAVING JURISDICTION and Underwriters Laboratories Inc. (UL) approval for the decking when installed as a part of an assembly indicated on Drawings in which fire resistive construction ratings are required.
 - 2. Work of this section shall be in accordance with CBC.
- C. Manufacturers shall be members of Steel Deck Institute (SDI).

1.04 SUBMITTALS

- A. Shop Drawings: Drawings, sections and details indicate type of decking, location, finish, gage of metal, arrangement of sheets, necessary fabrication to incorporate decking into the Work, and relationship to openings and flashing.

1.05 QUALITY ASSURANCE

- A. General: Metal decking steel shall conform to requirements of strengths and properties of standards specified.

- B. Qualifications of Welders: Properly certified for the type of Work involved in compliance with CBC requirements.
- C. Continuous inspection of welding will be performed by a special inspector. Refer to Section 01 45 33 - Code-Required Special Inspections. The Project Inspector shall be responsible for monitoring the work of the special inspector to ensure that the inspection program is satisfactorily completed.
- D. Identification of metal decking steel shall conform to the standards specified in Section 01 45 33 - Code-Required Special Inspections.
 - 1. Fabricator shall furnish sufficient evidence to the Architect attesting compliance with specified requirements.
 - 2. Conform to CBC requirements. Unclassified or unidentified decking is not permitted. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having a minimum Fy of 33 Ksi. In addition, for decking having Fy greater than 33 Ksi, testing laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.
- E. Unidentifiable Steel: Steel which is not readily identifiable as to grade from markings and test records is not permitted to be provided as part of the Work of this section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ASC Steel Deck. (IAPMO # 0329)
- B. OR equal with valid IAPMO or ICC report that meets/exceeds minimum section properties noted on plan.

2.02 MATERIALS

- A. Metal Decking: Roll-formed sheets conforming to ASTM A653, with G90 zinc coating.
 - 1. Section properties shall conform to applicable provisions of latest edition of AISI - Specification for the Design of Cold-Formed Steel Structural Members.
- B. Flexible Closure Strips for Deck: Vulcanized, closed-cell, expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE #41.
 - 1. Brittleness Temperature: Minus 40 degrees F, ASTM D746.
 - 2. Flammability Resistance: Self-extinguishing,
- C. Metal Flashing and Closures: 22 gage minimum, with ASTM A653, G90 zinc coating.
- D. Shear Connectors: Headed stud type, ASTM A108 Grade 1015, cold-finished carbon steel complying with AISC specifications.

2.03 FABRICATION

- A. Corrugated sheets or sections shall be designed to support required live load between supporting members.
- B. Provide decking in lengths to span over three or more supports.
- C. Except as detailed otherwise, provide decking with interlocking side laps, 2 ½-inch minimum end bearing, and 1 ½-inch minimum side bearing.
- D. Welding: Provide materials and methods in accordance with recommendations of steel decking manufacturer and reviewed submittals. Hold decking tight to the supporting elements with screws or other means for proper welding or crimping of the decking edges. Conform to AWS D1.3, and to the patterns and weld types indicated, with welds

free from sharp edges and protrusions. Field coat welds and abraded surfaces at completion with an anodic type galvanizing repair paint. Omit the field paint coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.

PART 3 - EXECUTION

3.01 OPENINGS

- A. Cut and reinforce units to provide openings which are located and dimensioned on the structural and mechanical Drawings.
- B. Provide openings, or other Work not indicated on the Drawings.

3.02 INSTALLATION

- A. Install metal decking in accordance with decking manufacturers' recommendations, requirements of Drawings, Shop Drawings, and Specifications.
- B. Install metal decking on supporting steel framework and adjust to final position before permanently fastening in place.
 - 1. Install each unit to proper bearing on supports.
 - 2. Install units in straight alignment for entire length of run of cells with close registration of cells of one unit with those of abutting unit.
- C. Fasten decking to steel framework at ends of units and at intermediate supports. Welding shall be as indicated on Drawings.
- D. Fasten side laps between supports as indicated on Drawings.
- E. Perform field cutting parallel with cells in area between cells, leaving sufficient horizontal material to permit welding to support steel.
- F. Weld shear connectors to supports thru decking units as required by Drawings. Weld only on clean, dry surfaces. Do not weld shear connectors thru two layers of decking units.

3.03 METAL FLASHINGS AND CLOSURES

- A. Furnish, install, and weld in position, sheet metal closure flashing, closure angles, closure plates, profile plates, and shear plates.
- B. Close open ends of cell runs at columns, openings, walls, similar interruptions and termination.

3.04 FIELD QUALITY CONTROL

- A. Inspection: Install steel decking under continuous inspection according to CBC Chapter 1705.2.2.
 - 1. Not used.

3.05 CLEAN UP

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

3.06 PROTECTION

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

END OF SECTION

SECTION 05 50 00
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. Section Includes:
 - 1. Steel framing and supports for operable partitions.
 - 2. Steel framing and supports for countertops.
 - 3. Steel tube reinforcement for half-high partitions.
 - 4. Steel framing and supports for mechanical and electrical equipment.
 - 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 6. Steel ladders (not for elevator pits).
 - 7. Steel bollards permanently set in concrete footings.
 - 8. Steel bollards, removable, and set using preset sleeves.
 - 9. Steel pipe guards.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts indicated to be cast into concrete or built into unit masonry.
 - 2. Steel pipe sleeves indicated to be cast into concrete or built into unit masonry.
 - 3. Wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 2. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 - 3. Section 05 12 00 "Structural Steel Framing."

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

ICTC Callexico Intermodal Transit Center

METAL FABRICATIONS

IFB Deliverable

05 50 00 - 1

02/01/24

1. Nonslip aggregates and nonslip-aggregate surface finishes.
 2. Paint products.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for operable partitions.
 2. Steel framing and supports for countertops.
 3. Steel tube reinforcement for half-high partitions.
 4. Steel framing and supports for mechanical and electrical equipment.
 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 6. Steel ladders (not for elevator pits).
 7. Steel bollards permanently set in concrete footings.
 8. Steel bollards, removable, and set using preset sleeves.
 9. Steel pipe guards.
 10. Anchor bolts indicated to be cast into concrete or built into unit masonry.
 11. Steel pipe sleeves indicated to be cast into concrete or built into unit masonry.
 12. Wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. 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."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

- F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.079-inch nominal thickness.
 - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0677-inch minimum thickness; unfinished.
- G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- H. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- I. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

2.2 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 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts (Weathering): Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: 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/E 488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; 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, all hot-dip galvanized per ASTM F 2329.
- H. Post-Installed Anchors: chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.3 MISCELLANEOUS MATERIALS

- A. Anti-Corrosive Shop Primer: Either of following, compatible with finish paints specified to be used over it; use primer containing pigments that make it easily distinguishable from zinc-rich primer:
 1. Anti-Corrosive Alkyd Primer for Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 2. Rust-Inhibitive, Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- B. Zinc-Rich Primer: Either of following, compatible with finish paints specified to be used over it:
 1. Organic Zinc-Rich Primer: Solvent based, one component, anti-corrosive primer for complying the MPI#18.
 2. Inorganic Zinc-Rich Primer: Inorganic based, anti-corrosive primer complying the MPI#19.
 3. Epoxy Zinc-Rich Primer: Solvent based, two or three component, epoxy type complying with MPI#20.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.4 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 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 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 or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are 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.
- J. 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, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 STEEL SUPPORT FRAMING FOR OPERABLE PARTITIONS

- A. Fabricate supports from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- B. Shop Finish:
1. Anti-corrosive primer.
 2. Exception: Primer not required where framing is completely concealed in interior wall or ceiling construction.

2.6 STEEL SUPPORT FRAMING FOR COUNTERTOPS

- A. Fabricate "L" shaped steel tube weldments from two 24-inch lengths of 2-inch square, 3/16-inch wall steel tube. Attached tube, end to side, at 90-degree angle; butt weld joint all around.
1. Provide longer tube leg if indicated on Drawings.
- B. Shop Finish:
1. Anti-corrosive primer.

2.7 STEEL TUBE SUPPORT FRAMING FOR HALF-HIGH PARTITIONS

- A. Fabricate half-high wall support framing from square steel tubing 3-1/2 by 3-1/2 by 1/4 inch wall-thickness.
1. Cap wall supports with 1/4-inch- thick steel plate.

- B. Fabricate support framing with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all 4 corners for 1/4-inch anchor bolts.
 - 1. Where wall supports are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of support tubes.
 - 2. For thru-bolted wall supports, provide backing plate fabricated same as baseplate.
- C. Shop Finish:
 - 1. Anti-corrosive primer.
 - 2. Exception: Primer not required where framing is completely concealed in interior wall or ceiling construction.

2.8 STEEL FRAMING AND SUPPORTS FOR MECHANICAL AND ELECTRICAL EQUIPMENT

- 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.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Shop Finish:
 - 1. For Interior Dry Environment Locations: Anti-corrosive primer.
 - 2. Exception: Primer not required where framing is completely concealed in interior wall or ceiling construction.

2.9 STEEL FRAMING AND SUPPORTS FOR APPLICATIONS WHERE FRAMING AND SUPPORTS NOT SPECIFIED IN OTHER SECTIONS

- 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.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Shop Finish:
 - 1. For Interior Dry Environment Locations: Anti-corrosive primer.
 - 2. Exception: Primer not required where framing is completely concealed in interior wall or ceiling construction.

2.10 STEEL LADDERS (NOT FOR ELEVATOR PITS)

- A. General: Comply with ANSI A14.3.
- B. Space siderails 18 inches apart unless otherwise indicated.
- C. Siderails: Continuous, 3-inch members with eased edges spaced at 24 inches.
- D. Rungs:

1. Size: 1-inch-diameter solid round steel bars. Space rungs 7 inches from wall surface and 12 inches on center. Let rungs into side rails.
 2. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 3. Provide nonslip surfaces on top of each rung:
 - a. Provide 13 gauge three row non-slip surface is on top of each rung mechanically pressure punched or stamped.
 - b. Basis of Design Product: button hole type as manufactured by McNichols Company, or approved equal.
 - c. By coating rung with aluminum-oxide granules set in epoxy-resin adhesive.
- E. Anchor Brackets:
1. As indicated on Drawings.
 2. Angle: 3-1/4 inch by 7-1/4 inch by 2-1/2 inches wide.
 3. Minimum two per stringer, maximum spacing 60 inches on center and within 24 inches of unsupported or unanchored ends.
- F. Shop Finish: Include brackets and fasteners:
1. Anti-corrosive primer.

2.11 STEEL BOLLARDS, PERMANENTLY SET IN CONCRETE FOOTINGS

- A. Fabricate metal bollards from steel shapes, as indicated.
1. Cap bollards with 1/4-inch- thick steel plate.
 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Shop Finish:
1. Galvanized and primed with shop primer for galvanized steel.

2.12 STEEL BOLLARDS, REMOVABLE, SET USING PRESET SLEEVES

- A. Fabricate metal bollards from steel shapes, as indicated.
1. Cap bollards with 1/4-inch- thick steel plate.
 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Recessed Sleeve: Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- C. Projecting Sleeve: Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.
- D. Shop Finish:
1. Galvanized and primed with shop primer for galvanized steel.

2.13 STEEL PIPE AND DUCT GUARDS

- A. Unless otherwise indicated on drawings, fabricate pipe and duct guards from 3/8-inch-thick by 12-inch-wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.
- B. Shop Finish:
 - 1. Anti-corrosive primer.
 - 2. Galvanized.

2.14 LADDER SAFETY SYSTEMS

- A. Climbing Ladder Fall Arrest System (CLAFS): Comply with 29 CFR 1910.29, 29 CFR 1926.1053, Section 7 of ALI A14.3 and ANSI/ASSP Z359.16; climbing ladder fall arrest system allows worker to climb up and down using both hands; does not require employee continuously, hold, push, or pull any part of system while climbing.
 - 1. Install on new fixed ladders over 24 feet in height.
 - 2. Anchorage: Fixed ladder meeting requirements of 29 CFR 1910.23.
 - 3. Flexible Carrier: Fixed 3/8 inch diameter stainless steel wire rope lifeline with shock absorber and top, bottom and intermediate supports; meeting requirements of ANSI/ASSP Z359.16.
 - 4. Rigid Carrier: Fixed 304 stainless steel U-shaped slotted track with top, bottom and intermediate supports; meeting requirements of ANSI/ASSP Z359.16.
 - 5. Fall Arrester: Stainless steel and aluminum automatic pass-through carrier sleeve fall arrester meeting requirements of ANSI/ASSP Z359.15 and ANSI/ASSP Z359.16; compatible with carrier.
- B. Personal Fall Arrest System Components; 29 CFR 1910.140:
 - 1. Body Support: Full body harness meeting requirements of ANSI/ASSP Z359.11; equipped with front or hip D-rings for attachment to climbing ladder fall arrest system.
 - 2. Connecting Means: Connecting hardware, such as a locking carabiner, meeting requirements of ANSI/ASSP Z359.12; compatible with fall arrester and body support harness.

2.15 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. 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.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Items Indicated to Receive Anti-Corrosive Shop Primer: SSPC-SP 3, "Power Tool Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to 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.

2.17 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

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 screws, 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.

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. Framing for Operable Partitions: Anchor supports securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS PERMANENTLY SET IN CONCRETE FOOTINGS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches 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.
 - 1. Do not fill removable bollards with concrete.

3.4 INSTALLING METAL BOLLARDS, REMOVABLE, SET USING PRESET SLEEVES

- A. Anchor external sleeves for removable bollards in concrete with pipe sleeves preset and anchored into concrete.
- B. Place removable bollards into sleeves.
- C. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- D. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- E. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

3.5 INSTALLING PIPE AND DUCT GUARDS

- A. Provide pipe and duct guards at exposed vertical pipes in garage where not protected by curbs or other barriers. Unless indicated otherwise, install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

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 dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting."

- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

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. Stainless steel pipe and tube railings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of 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.

1.4 ACTION 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 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 connecting and finishing members at intersections.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- C. Evaluation Reports: For post-installed anchors , from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, 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. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F.

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.

2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- 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. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, G90 coating, commercial steel Type B, thickness and pattern as indicated on Drawings.
- F. Brackets, Flanges, and Anchors:
 - 1. Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 2. Provide brackets with 1-1/2-inch clearance from inside face of handrail to finished wall surface.
 - 3. Bracket Type:
 - a. With flange tapped for concealed anchorage to threaded hanger bolt.
 - b. With predrilled hole for exposed bolt anchorage.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Steel Railings:
 - a. Ungalvanized: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
 - b. Hot-Dip Galvanized: 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. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction 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 Phillips 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 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, 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, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

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. Anti-Corrosive Shop Primer: Either of the following, compatible with finish paints specified to be used over it; use primer containing pigments that make it easily distinguishable from zinc-rich primer.
 1. Anti-Corrosive Alkyd Primer for Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 2. Rust-Inhibitive, Water-Base Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- E. Zinc-Rich Primer: Either of following, compatible with finish paints specified to be used over it:
 1. Organic Zinc-Rich Primer: Solvent based, one component, anti-corrosive primer complying with MPI#18.
 2. Inorganic Zinc-Rich Primer: Inorganic based, anti-corrosive primer complying with MPI#19.
 3. Epoxy Zinc-Rich Primer: Solvent based, two or three component, epoxy type complying with MPE#20.
- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- G. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- H. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- J. 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: 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 for the following locations:

- a. Exterior locations.
- b. Interior locations subject to water spray or immersion.

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. Shop assemble railings 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 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 are exposed to weather in a manner that excludes 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. 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.
- H. 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.
- I. Form changes in direction of railings as indicated on Drawings; where not indicated use either bending or prefabricated fittings at contractor's option.
 - 1. For changes in direction made by bending, use 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.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- M. 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.
- N. For railing posts set in concrete, provide sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
1. For steel railings provide steel sleeves.
 2. For aluminum railings provide stainless-steel sleeves.
 3. For stainless-steel railings provide stainless-steel sleeves.
- O. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- P. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from galvanized steel.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
 2. Orient perforated metal with pattern as indicated on Drawings.
- Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

- A. 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.
- B. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
1. Railings Indicated to Receive Anti-Corrosive Shop Primer: SSPC-SP 3, "Power Tool Cleaning."

- D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 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.
- E. High-Performance Coating: Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Apply zinc-rich epoxy primer of formulation compatible with epoxy intermediate coat.
 - 2. Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces.
 - 3. 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 are 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 are 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.
 - 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.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- 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. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

- A. Setting Posts in Metal Sleeves Cast in Concrete : Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions. Dress joint as indicated on Drawings.
- B. Anchoring Flanged Posts to Substrate:
 - 1. Anchor posts to surfaces indicated with oval or rectangular flanges, angle type flanges, or floor type flanges as required by conditions, connected to posts and to supporting members using following type of fittings:
 - a. Attach posts using fittings designed and engineered for this purpose.
 - b. Weld flanges to post.
 - 1) Bolt flanges to supporting surfaces.
 - 2) Weld flanges to metal supporting surfaces.
 - 2. Secure bolted post flanges to building construction as follows:
 - a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - b. For hollow masonry anchorage, use toggle bolts.
 - c. For wood framing or substrate, use hanger or lag bolts set into solid wood material. Coordinate with carpentry work to locate solid wood members of sufficient depth and strength to support railing loads.
 - d. For Steel-Framed Walls, Parapets and Similar Structures: One or more of the following as applicable for conditions indicated on Drawings:
 - 1) Use hanger or lag bolts set into wood backing between framing members (e.g. studs). Coordinate with framing installation to locate backing members.
 - 2) Use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 3) Use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements
- C. Install removable railing sections, where indicated, in slip-fit metal sockets.

3.5 ATTACHING RAILINGS

- A. **Anchoring Flanged Railing Ends to Substrate:** Anchor railing ends to walls and similar construction indicated, with round or square flanges, and as follows or as indicated on Drawings:
1. Weld flanges to railing ends.
 - a. Bolt or screw to flanges supporting construction.
 - b. Weld flanges to supporting metal substrates.
 2. Connect flanges to railing ends using non-welded connectors.
 - a. Bolt or screw to flanges supporting construction.
 - b. Weld flanges to supporting metal substrates.
- B. **Anchoring Mid-Rail Brackets to Substrate:** Attach railings to walls and similar construction with midrail wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Anchor brackets as indicated on Drawings.
- C. **Mechanically Fastening Flanges and Brackets:** Secure railing flanges and brackets that are bolted or screwed to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 4. For steel-framed partitions, walls, parapets and similar construction use one or more of the following as applicable for conditions indicated on Drawings:
 - a. Use hanger or lag bolts set into backing between framing members (e.g. studs). Coordinate with framing installation to locate backing members.
 - b. Use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - c. Use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

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 requirements for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. **Galvanized Surfaces:** Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

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.

END OF SECTION

SECTION 06 10 53
MISCELLANEOUS ROUGH CARPENTRY

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. Wood blocking - Architectural work.
 2. Wood blocking - Utility work.
 3. Wood nailers - Architectural work.
 4. Wood nailers - Utility work.
 5. Equipment backing panels, interior exposure - Architectural work.
 6. Fire-retardant treatment (FRT).
 7. Fasteners.
 8. Metal framing anchors.
 9. Adhesives.
 10. Separator sheeting.

1.3 REFERENCES

- A. Acronyms:
1. WCLIB - West Coast Lumber Inspection Bureau.
 2. WWPA - Western Wood Products Association.
- B. Definitions:
1. Applications:
 - a. Architectural Work: Applications for carpentry work requiring a greater degree of precision, less warp, less bow, fewer knots and other defects which may affect finish tolerances and other performance of the Work.
 - b. Utility Work: Applications for carpentry where economy is of greater importance than precision and performance of the Work; temporary rough carpentry.
 2. Blocking: Wood material typically concealed in other construction used to secure, join, or reinforce members, or to fill spaces between them, or to attach other construction such as fixtures, accessories, casework, and other materials.
 3. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
 4. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

5. Nailer: Wood pieces attached to a surface, used as a base for fastening another material.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 1. Fire-retardant-treated wood.
 2. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Named Wood Species: Lumber species named in this Section may be known by other names (e.g. Idaho white pine may also be known as Western white pine or White pine). Provide named species or same species as known by another name that can be verified in an authoritative reference such as "The Encyclopedia of Wood", Sterling Publishing Co., Inc.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - a. If acceptable with Authorities having Jurisdiction, markings may be omitted if certificates of grade compliance issued by grading agency are submitted.

3. Dress lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber:
1. 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.

2.2 FIRE-RETARDANT-TREATED (FRT) MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Lumber: Kiln-dry after treatment to a maximum moisture content of 19 percent.
- D. Plywood: Kiln-dry after treatment to a maximum moisture content of 15 percent.
- E. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber or plywood indicated to receive a stained or natural finish, mark end or back of each piece.
 - a. If acceptable with Authorities having Jurisdiction, markings may be omitted if certificates of treatment compliance issued by inspection agency are submitted.
- F. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- G. Application: Treat items indicated on Drawings, and the following:
1. Equipment backing panels, interior exposure - Architectural work.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide the following miscellaneous lumber where indicated and lumber for support or attachment of other construction.

B. Blocking - Architectural work:

1. General:

- a. Where used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- b. Where not used for attachment of other construction, Stud, No. 3, Standard, or Utility grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2. Dimension Lumber:

- a. Species: Any of following:
 - 1) WCLIB; Hem-fir, Spruce-pine-fir (south), or other western wood.
 - 2) WWPA; Hem-fir, Spruce-pine-fir (south), or other western wood.
- b. Provide wood-preservative-treated (WPT) lumber where indicated.

3. Plywood: Limit use only for attaching other construction such as fixtures, accessories, casework, and other materials.

- a. DOC PS 1, Exposure 1, Grade C-D Plugged or better.
- b. Nominal Thickness:
 - 1) Not less than 1/2-inch unless indicated otherwise.
 - 2) As indicated on Drawings.
 - 3) Not less than 3/4-inch where used to support railings, handrails, grab bars, seating, and similar conditions.

C. Blocking - Utility work:

1. General:

- a. Where used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- b. Where not used for attachment of other construction, Stud, No. 3, Standard, or Utility grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2. Dimension Lumber:

- a. Species: Any of following:
 - 1) WCLIB; Hem-fir, Spruce-pine-fir (south), or other western wood.
 - 2) WWPA; Hem-fir, Spruce-pine-fir (south), or other western wood.
- b. Provide wood-preservative-treated (WPT) lumber where indicated.

3. Plywood: Limit use only for attaching other construction such as fixtures, accessories, casework, and other materials.

- a. DOC PS 1, Exposure 1, Grade C-D Plugged or better.

- b. Nominal Thickness:
 - 1) Not less than 1/2-inch unless indicated otherwise.
 - 2) As indicated on Drawings.
 - 3) Not less than 3/4-inch where used to support railings, handrails, grab bars, seating, and similar conditions.

D. Nailers - Architectural work:

- 1. General: Where used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- 2. Dimension Lumber:
 - a. Species: Any of following:
 - 1) WCLIB; Hem-fir, Spruce-pine-fir (south), or other western wood.
 - 2) WWPA; Hem-fir, Spruce-pine-fir (south), or other western wood.
- 3. Board Lumber:
 - a. Species: Any of following:
 - 1) WCLIB; Hem-fir, Hem-fir (north), Spruce-pine-fir (south), Spruce-pine-fir, or other western woods.
 - 2) WWPA; Hem-fir, Hem-fir (north), Spruce-pine-fir (south), Spruce-pine-fir, or other western woods.
- 4. Provide wood-preservative-treated (WPT) lumber where indicated.

E. Nailers - Utility work:

- 1. General: Where used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- 2. Dimension Lumber:
 - a. Species: Any of following:
 - 1) WCLIB; Hem-fir, Spruce-pine-fir (south), or other western wood.
 - 2) WWPA; Hem-fir, Spruce-pine-fir (south), or other western wood.
- 3. Board Lumber:
 - a. Species: Any of following:
 - 1) WCLIB; Hem-fir, Hem-fir (north), Spruce-pine-fir (south), Spruce-pine-fir, or other western woods.
 - 2) WWPA; Hem-fir, Hem-fir (north), Spruce-pine-fir (south), Spruce-pine-fir, or other western woods.
- 4. Provide wood-preservative-treated (WPT) lumber where indicated.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels, Interior Exposure - Architectural Work:

1. Plywood, DOC PS 1, Exposure 1, Grade A-C.
 - a. Nominal Thickness: Not less than 3/4-inch unless indicated otherwise on Drawings.
 - b. Provide fire-retardant-treated (FRT) plywood where indicated.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Provide fasteners either with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel for the following work:
 - a. Carpentry exposed to weather.
 - b. Carpentry in areas of high relative humidity.
 - c. Interior carpentry pressure-preservative treated (WPT).
 - d. Carpentry fire-resistive-treated (FRT).
 2. Provide only Type 304 stainless steel fasteners for the following work:
 - a. Exterior carpentry pressure-preservative treated (WPT).
 - b. Carpentry is in contact with ground.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Wood Screws: ASME B18.6.1.
- D. Screws for Fastening to Metal Framing: Length as recommended by screw manufacturer for material being fastened and complying with the following for metal thickness fastened to:
 1. ASTM C 1002 for following metal thicknesses:
 - a. 18 mil (25 gage).
 - b. 27 mil (22 gage).
 - c. 30 mil (20 gage drywall).
 2. ASTM C 954 for following metal thicknesses:
 - a. 33 mil (20 gage structural).
 - b. 43 mil (18 gage).
 - c. 54 mil (16 gage).
 - d. 68 mil (14 gage).

2.6 METAL FRAMING ANCHORS

- 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. Cleveland Steel Specialty Co.
 2. KC Metals Products, Inc.
 3. Phoenix Metal Products, Inc.

4. Simpson Strong-Tie Co., Inc.
 5. USP Structural Connectors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
1. Use for interior locations unless otherwise indicated.

2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Rough Carpentry to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- B. Separator Sheeting: Flexible flashing composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch .
1. Do not use butyl rubber sheeting over substrates containing asphaltic compounds.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate supports to comply with requirements for attaching other construction.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 2. ICC-ES evaluation report for fastener.
- G. Fastening to Wood: Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

- H. Fastening to Metal: Use screw type fasteners unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Do not countersink screw heads unless otherwise indicated.
- I. Bolt and Nut Fastening: Where indicated, bolt and nut fasten carpentry work. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.2 WOOD BLOCKING INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading.

3.3 WOOD NAILERS INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading.

3.4 PLYWOOD BACKING PANEL INSTALLATION

- A. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- B. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Fasten panels to studs to support applied loading.
 - 1. Screw to metal stud wall framing not less than 12 inches o.c. vertically at each stud.

3.5 PROTECTION

- A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 16 00

SHEATHING

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. Wall sheathing of following type(s).
 - a. Plywood.
 - b. Glass-mat gypsum.
 - 2. Parapet sheathing of following type(s).
 - a. Plywood.
 - b. Glass-mat gypsum.
 - 3. Wood-preservative treatment (WRT).
 - 4. Fasteners.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings.

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
1. Type and Thickness: Regular, 1/2 inch thick unless indicated otherwise on Drawings.
 - a. Provide Type X, 5/8 inch at fire resistive rated wall assemblies.

2.3 PARAPET SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
1. Type and Thickness: Type X, 5/8 inch thick.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Roof, Parapet, and Wall Sheathing Fasteners:
 - a. Provide one of following at contractor's discretion, unless indicated otherwise:
 - 1) Fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 2) Fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 3) Fasteners of Type 304 stainless steel.
 - b. Provide fasteners either with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel for the following Work:
 - 1) Sheathing exposed to weather.
 - 2) Sheathing in areas of high relative humidity.
 - 3) Interior exposed sheathing that is pressure-preservative treated (WPT).

- 4) Sheathing that is fire-resistive-treated (FRT).
- c. Provide only Type 304 stainless steel fasteners for the following Work:
 - 1) Sheathing that is part of exterior building envelope that is pressure-preservative treated (WPT).
 - 2) Sheathing that is in contact with earth or below grade.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
1. For steel framing with the following metal thickness, use screws that comply with ASTM C 1002:
 - a. 18 mil (25 gage).
 - b. 27 mil (22 gage).
 - c. 30 mil (20 gage drywall).
 - d. Less than 0.0329 inch .
 2. For steel framing with the following metal thickness, use screws that comply with ASTM C 954:
 - a. 33 mil (20 gage structural).
 - b. 43 mil (18 gage).
 - c. 54 mil (16 gage).
 - d. 68 mil (14 gage).
 - e. From 0.033 to 0.112 inch .

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

END OF SECTION

SECTION 06 41 16

PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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. Plastic-laminate-faced architectural cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.
- B. Related Requirements:
 - 1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 REFERENCES

- A. Acronyms:
 - 1. AWS - Architectural Woodwork Standards and its joint adoptees and publishers including:
 - a. WI - Woodwork Institute.
- B. Definitions:
 - 1. Exposed Surfaces: (See AWS for detailed inclusions and exclusions.)
 - a. Exterior surfaces exposed to view.
 - b. Interior surfaces exposed to view in open casework or behind transparent doors.
 - 2. Semi-Exposed Surfaces: Interior surfaces only exposed to view when doors or drawers are opened. (See AWS for detailed inclusions and exclusions.)
 - 3. Concealed surfaces: Exterior or interior surfaces that are covered or not normally exposed to view. (See AWS for detailed inclusions and exclusions.)

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Documentation shall be provided verifying that compliant finish materials have been used.

ICTC Calexico Intermodal Transit Center

PLASTIC-LAMINATE-FACED ARCHITECTURAL
CABINETS
06 41 16 - 1
02/01/24

IFB Deliverable

- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
- D. Samples for Initial Selection:
 - 1. Plastic laminates.
 - 2. PVC edge material.
 - 3. Thermoset decorative panels.
- E. Samples for Verification:
 - 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material.
 - 2. Wood-grain plastic laminates, 12 by 24 inches, for each type, pattern and surface finish, with one sample applied to core material.
 - 3. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
 - 4. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
 - 5. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator and installer.
- B. Product Certificates: For each type of product.
 - 1. Composite wood and agrifiber products.
 - 2. Thermoset decorative panels.
 - 3. High-pressure decorative laminate.
 - 4. Adhesives.

1.7 QUALITY ASSURANCE

- A. Fabricator and Installer Qualifications:
 - 1. Fabrication shop and installer that employs skilled workers who custom fabricate and install products similar to those required for this Project and whose products have a record of successful in-service performance. Fabrication shop and installer need not be the same unless indicated otherwise below.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

ICTC Calxico Intermodal Transit Center

PLASTIC-LAMINATE-FACED ARCHITECTURAL
CABINETS
06 41 16 - 2
02/01/24

IFB Deliverable

1. Build mockups of typical plastic-laminate cabinets as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Grade: Premium.
- B. Type of Construction: Type A - Frameless.
- C. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

ICTC Calexico Intermodal Transit Center

PLASTIC-LAMINATE-FACED ARCHITECTURAL
CABINETS
06 41 16 - 3
02/01/24

IFB Deliverable

- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
1. Basis-of-Design Product: Subject to compliance with requirements, provide:
 - a. Product indicated on Drawings.
 - b. Or comparable product by one of the following:
 - 1) Abet Laminati, Inc.
 - 2) Formica Corporation.
 - 3) Lamin-Art, Inc.
 - 4) Panolam Industries International, Inc.
 - 5) Wilsonart International; Div. of Premark International, Inc.
- E. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HGL.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.
 4. Edges: Grade VGS.
 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- F. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC T-mold matching laminate in color, pattern, and finish.
 - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.
 2. Drawer Sides and Backs: Hardwood plywood.
 3. Drawer Bottoms: Hardwood plywood.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by laminate manufacturer's designations as indicated on Drawing's Finish Legend.

2.3 WOOD MATERIALS

- A. Hardwood plywood, particleboard, and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the formaldehyde limits per section 5.504.4.5.
- B. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- C. Composite Wood and Agrifiber Products:
 - 1. Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
 - 4. Softwood Plywood: DOC PS 1.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, soft self-closing.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
 - 1. Basis-of-Design Product: Doug Mockett & Company, Inc.; DP3B/2 - 4 inch long with 2 inch profile tab pull.
- D. Grommets:
 - 1. Basis-of-Design Product: Doug Mockett & Company, Inc.; MBG1/A - 2-3/8" diameter metal brush desk grommet with removable cap.
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
 - 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
- G. Door Locks: BHMA A156.11, E07121.

- H. Drawer Locks: BHMA A156.11, E07041.
- I. Door and Drawer Silencers: BHMA A156.16, L03011.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 2. Satin Stainless Steel: BHMA 630.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: , kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate:
 - 1. For the following uses:
 - a. General Use: Unpigmented contact cement, contact cement, PVA, or resorcinol.
 - 2. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

- A. Fabricate cabinets to dimensions, profiles, and details indicated.
- B. Provide locks on all drawers and cabinets, unless otherwise noted.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. using following fastener types:
 - a. Wood Framing, Blocking or Hanging Strips: No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood.
 - b. Metal Backing or Framing Behind Wall Finish:
 - 1) No. 10 wafer-head sheet metal screws.
 - 2) Toggle bolts.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

ICTC Calxico Intermodal Transit Center

PLASTIC-LAMINATE-FACED ARCHITECTURAL
CABINETS
06 41 16 - 7
02/01/24

IFB Deliverable

SECTION 06 61 16.13

SOLID SURFACING COUNTERTOPS

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. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
 - 4. Solid surface material sinks.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials and sinks.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.
 - 2. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches , of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 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. Avonite Surfaces.
 - b. E. I. du Pont de Nemours and Company.
 - c. Formica Corporation.
 - d. LG Chemical, Ltd.
 - e. Meganite Inc.
 - f. Samsung Chemical USA, Inc.
 - g. Swan Corporation (The).
 - h. Transolid Div of Trumbull Industries.

- i. Wilsonart International Holdings, Inc.
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
4. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 1. Grade: Custom.
- B. Configuration:
 1. Front: Straight, slightly eased at top.
 2. Backsplash: Straight, slightly eased at corner.
 3. End Splash: Matching backsplash.
- C. Countertops: 1/2-inch- thick, solid surface material.
- D. Backsplashes: 1/2-inch- thick, solid surface material.
- E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 1. Install integral sink bowls in countertops in the shop.
- F. Joints: Fabricate countertops in sections for joining in field.
 1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
- G. Cutouts and Holes:
 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

- b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
 - c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
- 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4-inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- F. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

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. Extruded polystyrene foam-plastic board.
2. Glass-fiber blanket.
3. Glass-fiber board.
4. Mineral-wool blanket.
5. Mineral-wool board.
6. Fasteners.

- B. Applications include:

1. Under slab-on-grade.
2. On slab-on-grade edges.
3. On interior foundation wall surfaces backfilled.
4. On exterior foundation walls surfaces backfilled.
5. Continuous on exterior walls.
6. In framed construction cavities.
7. In curtain-wall cavities.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

- B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Applications include:
 - a. On slab-on-grade edges.
 - b. On interior foundation wall surfaces.
 - c. On exterior foundation wall surfaces.
 - 2. Thermal Resistance (R Value): Minimum 5.0/inch.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- C. Extruded Polystyrene Board, Type VII: ASTM C 578, Type VII, 60-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Applications include:
 - a. Under slab-on-grade.
 - b. Under roof deck pavers
 - 2. Thermal Resistance (R Value): Minimum 5.0/inch.

2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 GLASS-FIBER BOARD

- A. Glass-Fiber Board, Unfaced: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics. Nominal density of 2.25 lb/cu. ft, thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.4 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.5 MINERAL-WOOL BOARD

- A. Mineral-Wool Board for Continuous Insulation, Unfaced: ASTM C 612, Types IA, IB, II, III, IVA, or IVB; Categories 1 or 2; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Applications include:
 - a. Continuous exterior wall insulation.
 - 2. Thermal Performance:
 - a. R Value: Minimum 4.2/inch.
 - b. Thermal Conductivity: Not greater than 0.24 Btu in./h sq.ft. deg. F/inch at 75 deg. F.
 - 3. Nominal Density: 4 lb/cu. ft. minimum and 6 lb/cu. ft. maximum.
 - 4. Fiber Color: Dark color at walls with open joint cladding.
- B. Mineral-Wool Board, Type III, Unfaced: ASTM C 612, Type III; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 8 lb/cu. ft..

2.6 INSULATION FASTENERS

- A. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 - 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- B. Fasteners for Fastening Insulation to Cold-Formed Metal Framing: Provide screws with plastic cap washers.
 - 1. Screws: Steel drill screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - a. Length: As required to produce not less than 3 screw threads visible on backside of face of metal stud.
 - b. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
 - c. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.
 - 2. Plastic Cap Washers: Approximately 1 inch o.d. with fastener hole in center.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Ideal Security Inc.; Plastic Cap Washer SKPHC.

2) Or Equal.

2.7 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION UNDER SLAB-ON-GRADE

- A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.
 - 2. Stagger end joints and tightly abut insulation units.
 - 3. Seal seams and penetrations with joint tape centered over joints.

3.4 INSTALLATION AT SLAB-ON-GRADE EDGES

- A. On vertical slab edge surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

3.5 INSTALLATION AT FOUNDATION WALL INTERIOR FACE

- A. On vertical foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

3.6 INSTALLATION AT FOUNDATION WALL EXTERIOR FACE

- A. Butt panels together for tight fit.
- B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.7 INSTALLATION OF CONTINUOUS INSULATION ON EXTERIOR WALLS

- A. Board Insulation: Install insulation units continuously over exterior wall substrates indicated and as follows:
 - 1. For metal stud wall framing, hold insulation in place by securing with metal screws with plastic caps specified, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place, but not greater than 24 inches o.c. Avoid compressing insulation with fasteners.
 - 2. For Masonry or Concrete Substrates: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face of insulation and as recommended by manufacturer. Fit courses of insulation with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 3. Where indicated, Z-furring members may be used to retain edges of insulation in lieu of fasteners.

3.8 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

- C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

3.9 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.
 - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
 - 2. Install insulation to fit snugly without bowing.

3.10 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 26 16
BELOW-GRADE VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes vapor retarders for use beneath concrete slabs set on earthen grade and receiving floor finishes sensitive to the transmission of water vapor from below. Section includes the following:
 - 1. Vapor retarder with Performance Class A sheet membrane.
 - 2. Vapor retarder tape.
 - 3. Aggregate fill materials used with vapor retarder.
- B. Locate vapor retarder where indicated on Drawings.
- C. Related Sections:
 - 1. Section 03 30 00 "Cast-In-Place Concrete" for concrete slabs.

1.3 REFERENCES

- A. ACI - American Concrete Institute:
 - 1. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."

1.4 DEFINITIONS

- A. Floor Finishes Sensitive to Water Vapor Transmission:
 - 1. Materials bonded to concrete slab using latex, acrylic, epoxy, or water-solvent-based adhesives.
 - 2. Materials specified to be installed on concrete tested for moisture-vapor-emission rate not exceeding 3 lb. of water/1000 sq. ft. in 24 hours or for relative humidity level not exceeding 75 percent.
 - 3. Paints and coatings with alkyd, urethane, epoxy, acrylic, or silicone formulations.
 - 4. Resilient sheet or tile flooring including vinyl, rubber, and linoleum products.
 - 5. Carpeting with synthetic, vinyl, or other plastic material backing.
 - 6. Access flooring supported by pedestals bonded to concrete slab with epoxy adhesive.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review vapor-retarder installation.

1.6 ACTION SUBMITTALS

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

ICTC Calxico Intermodal Transit Center

BELOW-GRADE VAPOR RETARDERS

IFB Deliverable

07 26 16 - 1

02/01/24

- B. Samples: For vapor retarder and tape.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For vapor retarder, signed by manufacturers.
- C. Minutes of preinstallation conference.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Installer must be certified or approved by vapor retarder manufacturer.
- B. Mockups: Demonstrate typical joints and standard of workmanship.
 - 1. Place approximately 200 sq. ft. in the location indicated or, if not indicated, as directed by Owner.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain vapor retarder sheet, tape, sealants, and adhesives from single source from single manufacturer.

2.2 VAPOR RETARDERS

- A. Preformed, flexible sheet material complying with ASTM E 1745, Performance Class A.
 - 1. Water Vapor Permeance: Maximum 0.1 perms or 0.1 gr/(h x sq.ft. x in.Hg).
 - 2. Tensile Strength: Minimum 45.0 lbf/in..
 - 3. Puncture Resistance: Minimum 2200 g.
 - 4. Include manufacturer's recommended adhesive tape or pressure-sensitive tape.
 - 5. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra 15.
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Meadows, W. R., Inc.; Perminator 15 mil.
 - e. Raven Industries Inc.; Vapor Block 15.
 - f. Stego Industries, LLC; Stego Wrap 15 mil Class A.
- B. Vapor Retarder Tape: Adhesive tape or pressure-sensitive joint tape recommended by vapor retarder manufacturer for sealing, hanging, seaming, splicing, and patching sheet vapor retarder.

2.3 AGGREGATE FILL MATERIALS

- A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install vapor retarders below interior concrete slabs-on-grade on prepared subgrade where indicated on Drawings.
- B. Placement Method: Place vapor retarder as indicated in ACI 302.1R, using one of the following Methods for the conditions indicated:
 - 1. Method 1: For conditions where earthen grade is directly exposed to the overhead sky and will get wet when it rains:
 - a. Place vapor retarder over 3 inches of well graded fine-graded granular material or sand, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch .
 - b. Concrete slab is placed directly on vapor retarder.
- C. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.2 PROTECTION

- A. Protect vapor retarder from damage including cutting and puncturing. If vapor retarder is damaged during subsequent construction operations repair damage and reseal vapor retarder before placing concrete.

END OF SECTION

SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIERS

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. Related Requirements:
 - 1. Section 04 42 00 - Unit Masonry for concrete masonry unit backup and through-wall flashing.
 - 2. Section 09 22 16 - Non-Structural Metal Framing for exterior wall framing.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- B. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
 - 1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, window, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.
- C. Independent Testing: Product installed on project shall be listed on the Air Barrier Association of America (ABAA) web site, and shall comply with the ABAA listed definition of an air barrier.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

- A. High-Build, Vapor-Retarding Air Barrier: Modified bituminous membrane with an installed dry film thickness, according to manufacturer's written instructions, of 40 mils or thicker over smooth, void-free substrates.
 - 1. Modified Bituminous Type.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Carlisle Coatings & Waterproofing Inc; Barriseal.
 - 2) Henry Company, Sealants Division; Air-Bloc 06 WB.
 - 3) Tremco Incorporated; ExoAir 120.
 - 4) W.R. Meadows, Inc; Air-Shield LM.
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft.pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M, Desiccant Method.
 - c. Adhesion to Substrate: Minimum 25 when tested according to ASTM D 4541.
 - d. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - e. UV Resistance: Can be exposed to sunlight for 4 months according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 3. Verify that substrates are visibly dry and free of moisture.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.3 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.

2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
 - C. Remove masking materials after installation.

END OF SECTION

SECTION 07 41 13.16
STANDING SEAM METAL ROOF PANELS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Standing-seam roof panels.
 - 2. Trim, flashing, and roof drainage at metal roofing.
- B. Related Sections include the following:
 - 1. Section 07 62 00 - Sheet Metal Flashing and Trim for flashing not part of roofing and other sheet metal work.
 - 2. Section 07 92 00 - Joint Sealants for field-applied sealants.

1.3 REFERENCES

- A. Definitions
 - 1. Basis of Design: The designated metal roof panel system, panel profile including dimensions, panel “color design” and paint system, attachment method, wind performance and all other attributes which manufacturers must provide, meet or exceed, to the satisfaction of the Architect, in order to be used on the project. The Architect is the sole arbiter in determining whether a product is equal to the “Basis of Design”.
 - 2. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.
 - 3. Solar Flux: Direct and diffuse radiation from the sun received at ground level over the solar spectrum, expressed in watts per square meter.
 - 4. Solar Reflectance: Fraction of solar flux reflected by a surface, expressed as a percent or within the range of 0.00 and 1.00.
 - 5. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Unless more stringent requirements are indicated, comply with ASTM E 1514.
- C. Wind-Uplift Resistance: Provide roof panel assemblies that meet requirements of UL 580 for Class 90 wind-uplift resistance.

- D. Structural Performance: Provide manufactured roof panel assemblies capable of safely supporting design loads indicated under in-service conditions with vertical deflection no greater than the following, based on testing manufacturer's standard units according to ASTM E 1592 by a qualified independent testing and inspecting agency.
 - 1. Maximum Deflection: 1/240 of the span.
- E. FM Approvals Listing: Provide metal roof panels and component materials that comply with requirements in FM Approvals 4471 as part of a panel 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-90.
- F. Air Infiltration: Air leakage through assembly of not more than the following when tested according to ASTM E 1680, based upon 16-inch-wide panel:
 - 1. Maximum 0.005 cfm/sq. ft. of roof area at test-pressure difference of minus 1.57 lbf/sq. ft.
 - 2. Maximum 0.016 cfm/sq. ft. of roof area at test-pressure difference of minus 12.00 lbf/sq. ft.
- G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.
- H. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

1.5 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
- B. Shop Drawings: Show layouts of panels on roofs, details of edge conditions, joints, panel profiles, supports, anchorages, trim, flashings, underlayment, closures, and special details. Distinguish between factory- and field-assembled work. In order for the panel manufacturer to agree to warrant the final roof installation, comply with the panel manufacturer's submittal requirements. Verify the requirements, if any, with the panel manufacturer prior to commencing shop drawing creation. The panel manufacturer requirements may include, but are not limited to, the following:
 - 1. Shop drawings required to be drawn by the panel manufacturer.
 - 2. Shop drawings required to be reviewed by the panel manufacturer prior to, or after, review by the Architect.
 - 3. Shop drawings review stamps from the manufacturer or from some manufacturer specified outside party – follow the required sequence of stamp collection

required by the panel manufacturer.

4. Shop drawings with prerequisite requirements unique to the manufacturer of the panels – coordinate requirements prior to signing contracts with panel manufacturer.
 5. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Verification: Provide sample panels 12 inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.
- 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 architects and owners, and other information specified.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
1. Metal Roof Panels: Include reports for air infiltration, water penetration, solar reflectance, and structural performance.
- F. Waiver Forms: Submit waiver forms, if any, (example: metal roofing "Pan Wave Form") with, and as part of the shop drawings. Waiver forms will not be reviewed if they do not accompany the other submittal documents; after review, the waiver forms may or may not be signed depending on what they say. Failure to comply with this requirement will be considered nonperformance of the requirements of this specification, and the manufacturer's product in this section, and other products specified in other specification sections, will not be allowed on subsequent projects.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed metal roof panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in- service performance.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state of California and who is experienced in providing engineering services of the kind indicated.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.
- B. Handling: Exercise care in unloading, storing, and erecting roof panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating roof panels without field measurements or allow for trimming panel units. Coordinate roof construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.9 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal roof panels within the specified warranty period and agreeing to repair finish or replace roof panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 METALS AND FINISHES

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755 and the following requirements:
 - 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 50 (ASTM A 792M, Class AZM150 coating designation, Grade 340); structural quality.
 - 2. Thickness: 0.034 inch, unless otherwise indicated.
 - 3. Surface: Smooth, flat finish.
 - 4. Finish: Apply the following organic coating in thickness indicated. Furnish appropriate air-drying spray finish in matching color for touchup.
 - a. 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 percent polyvinylidene fluoride resin by weight with a total minimum dry film

thickness of 0.9 mil and 30 percent reflective gloss when tested according to ASTM D 523.

- 1) Durability: Provide coating field tested under normal range of weather conditions without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D 4214; and without fading in excess of 5 Hunter units.
 - 2) Color: As selected by Architect from manufacturer's full range.
5. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.2 ROOF PANEL ASSEMBLIES

- A. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Factory-formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.
1. Clips: Low-movement floating clips to accommodate thermal movement; fixed where design permit, designed to meet negative-load requirements.
 - a. Material: 24 gage thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 2. Panel Seam: 2-inch standing seam panels.
 3. Joint Type: Field mechanically seamed, 180 degrees.
 4. Panel Shape: Flat.
 5. Panel Width: 12 inches.
 6. Eave Notch: Factory-formed.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Rheinzink Double Lock or comparable product by one of the following:
1. AEP Span; a BlueScope Steel company.
 2. CENTRIA Architectural Systems.
 3. MBCI; a division of NCI Building Systems, L.P.
 4. McElroy Metal, Inc.
 5. Metal Sales Manufacturing Corporation.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.3 THERMAL INSULATION

- A. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2 glass-fiber mat, Grade 3, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core. 0.02 perm. FM Approvals 4450/4470 approved. CFC-, HCFC-, and HFC- free.

1. Insulation Seam Tape: Manufacturer's recommended tape compatible with insulation facing and with adjacent air barrier transition material.

2.4 UNDERLAYMENT MATERIALS

- A. Waterproofing Membrane (Self-Adhering, High-Temperature Sheet): 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS- modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 degrees F; ASTM D 1970.
 2. Low Temperature Flexibility: Passes after testing at minus 20 degrees F; ASTM D 1970.
 3. Products: Subject to compliance with requirements, products which may be incorporated in the Work include the following:
 - a. CCW MiraDRI, Carlisle Coatings & Waterproofing Incorporated, Division of Carlisle Companies Incorporated.
 - b. Grace Ultra, Grace Construction Products.
 - c. Blueskin PE 200 HT, HENRY Company.
 - d. MetShield, Metal-Fab Manufacturing, WIP 300H.
- B. Building Paper: Minimum 5 lb/100 sq. ft., rosin sized.

2.5 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Zee Clips: 0.079-inch nominal thickness.
- C. Base or Sill Channels: 0.079-inch nominal thickness.
- D. Hat-Shaped, Rigid Furring Channels:
 1. Nominal Thickness: As required to meet performance requirements, but not less than 0.025 inch.
 2. Depth: As indicated.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.
 1. Nominal Thickness: As required to meet performance requirements.
- F. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.6 MISCELLANEOUS MATERIALS

- A. General: Provide materials required for a complete roof assembly and as recommended by roof panel manufacturer, unless otherwise indicated.
- B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, paperless, glass-mat facing on, or embedded into each side of a water-resistant gypsum core.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. Dens-Deck Roof Board, Georgia-Pacific 800-225-6119 www.gp.com
 2. Type and Thickness: Regular, 1/2 inch thick.
 3. Size: 48 by 96 inches.
- C. Thermal Spacers: Where panels attach directly to purlins, provide thermal spacers recommended by panel manufacturer.
- D. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
1. Use stainless-steel fasteners for exterior applications and galvanized steel fastener for interior applications.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Expansion-Joint Sealant: For hooked-type expansion joints that must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.

2.7 ACCESSORIES

- A. Accessories, General: Unless otherwise specified, provide components approved by roof panel manufacturer and required for a complete roof panel assembly including trim, copings, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.
1. Closures: Provide closures at eaves, fabricated of same metal as metal roof panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Panel Sealants: Provide one of the following identical to that used in test panels meeting performance requirements:
1. Pressure-sensitive, 99 percent solids, gray polyisobutylene or butyl rubber compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1 inch wide and 1/8 inch thick, with nylon spacer beads to prevent overcompression of the sealant tape.
 2. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311, with nylon spacer beads to prevent overcompression of the sealant tape.
- C. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.028 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- D. Pipe Penetration Flashing: Premolded EPDM pipe collar with flexible aluminum ring bonded to base and stainless steel pipe clamp to secure collar to pipe.
- E. Roof Curbs: Fabricated from aluminum sheet, minimum 0.080 inch thick; with bottom of

skirt profiled to match roof panel profiles, and welded top box, integral internal fastener flange, and water diverter. Fabricate curb subframing of minimum 0.0598-inch thick, angle-, C-, or Z-shaped galvanized steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch thick, rigid insulation.

2.8 FABRICATION

- A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
 1. Site-rolled fabrication of panels or shop-rolling of panels using fixed equipment designed for site-rolling applications does not meet the requirements of this Section.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate panel joints with captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 3. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof substrate to verify that substrate joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

3. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
5. Do not proceed with roof panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Substrate Board: Install substrate boards over roof substrate on entire roof surface. Attach with substrate- board fasteners.
 1. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
 2. 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.
- B. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.
- C. Coordinate metal panel roofing with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- D. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.3 BOARD INSULATION INSTALLATION

- A. General: Comply with insulation manufacturer's instructions and recommendations for the handling, installation, and bonding or anchorage of insulation to substrate. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Extend insulation in thickness indicated to cover entire roof. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Seal all joints and penetrations air- and vapor-tight.
- C. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- D. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- E. Secure insulation to deck using mechanical fasteners specifically designed and sized for attachment of specified board type insulation to deck type shown. Fasten insulation over entire area of roofing at spacing as required by FM for Windstorm Resistance Classification 1-90 and in accordance with requirements of appropriate UL Construction Number. Run long joints for insulation in continuous straight lines, perpendicular to roof slope with end joints staggered between rows. Fill gaps exceeding 1/4 inch with insulation.

- F. Seam Tape: Tape seams of board insulation to form unbroken air barrier across plane of insulation. Repair damaged facing with seam tape.
- G. Nailers: Install wood nailers of same thickness as insulation, set between insulation boards and spaced not more than 20 to 21 feet apart, depending on insulation board size. Anchor nailers to substrate. Run nailers perpendicular to slope of roof unless otherwise indicated.

3.4 PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Provide metal roof panels of full length from eave to eave unless otherwise indicated or restricted by shipping limitations.
 - 2. Install panels with concealed fasteners, unless otherwise indicated, at each standing-seam joint, at location, spacing, and fasteners recommended by manufacturer.
 - 3. Install panels over solid substrate with minimum 3:12 slope. Install 1 ply of underlayment from lower edge up, with at least 3 inch side laps and 4 inch end laps.
- B. Accessories: Install components required for a complete roof panel assembly including trim, copings, fasciae, clips, seam covers, battens, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- C. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.
- D. Install underlayment and building-paper slip sheet under metal panels, unless otherwise recommended by panel manufacturer. Install self-adhering high-temperature sheet underlayment where indicated or, if not indicated, as required or recommended by panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal panels. Apply from eave to eave in shingle fashion and lap joints a minimum of 2 inches.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.
 - 1. Flash and seal panels at eaves with rubber, neoprene, or other closures to exclude weather.
 - 2. Seal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by panel manufacturer.
 - 3. Prepare joints and apply sealants to comply with requirements of Section 07 92 00 - Joint Sealants.
- F. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion

and contraction. Predrill panels for fasteners.

1. Point of Fixity: Fasten each panel along a single line of fixing located at eave.
 2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.
- G. Standing-Seam Roof Panel Assembly: Fasten panels to supports with concealed clip according to panel manufacturer's written instructions.
1. Commence metal roof panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
 2. Field cutting exterior panels by torch or abrasive saw is not permitted.
 3. Locate and space fastenings in uniform vertical and horizontal alignment.
 4. Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturer's written instructions.
 5. Install clips at each support with self-drilling/self-tapping fasteners.
 6. Provide metal closures at rake edges.
 7. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
 8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.
 9. Install metal flashing to allow moisture to run over and off metal roof panels.
 10. At end laps of panels, install tape calk between panels.
 11. Seaming: Complete seaming of panel joints by operating portable power-driven equipment of type recommended by panel manufacturer to provide a weathertight joint.
 12. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 13. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 14. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates
- H. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.
- I. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 on slope and location lines as indicated and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

3.5 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements and manufacturer's written installation instructions. Provide concealed 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 weather resistant.
1. Form trim and transition joints using compressed joints with captive butyl sealant capable of resisting static water pressure. Cleated joints and exposed joint sealants do not meet this requirement.
 2. Install exposed flashing and trim 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.
 3. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- D. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
- E. Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with clamps or set screws in array recommended by snow guard manufacturer. Do not use fasteners that will penetrate metal roof panels.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Technical Representative: Engage a qualified manufacturer's technical representative acceptable to Owner for a minimum of 10 full-time days on site to perform substrate examination, interim observations, and final roof inspections, and to prepare reports. Inspections will be full time so if contractor takes longer than 10 days there will be a manufacturer's inspector on site.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon

as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION

SECTION 07 42 13
METAL WALL PANELS

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: Conceal-fastener, lap-seam metal steel wall panels for roof screens.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

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

1.10 COORDINATION

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

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Concealed-Fastener Metal Wall Panels:
1. Basis of Design Product: Subject to compliance with requirements, provide Centria CS-200 or comparable product by one of the following:

- a. Fabral.
 - b. MBCI; a division of NCI Group, Inc.
 - c. McElroy Metal, Inc.
 - d. Metal Sales Manufacturing Corporation.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Thickness: 18 gage.
 - b. Panel Profile: Single asymmetrical 7/8-inch deep rib.
 - c. Exterior Finish: Three-coat fluoropolymer.
 - d. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim".
- D. Steel Panel Fasteners: Self-tapping screws designed to withstand design loads.
- E. Zinc Panel Fasteners: Tile clips.
 - 1. Material: Hot dip galvanized steel or 300 series stainless steel.
 - 2. Pre-punched clips for attachment into substrate.
 - 3. Thickness: 0.02 inch (0.5 mm).
 - 4. Designed to withstand negative load requirements.
 - 5. Fasteners for Clip Attachment to Wood Substrate: #12, 300 series stainless steel, thread design and length appropriate for substrate.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: 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 same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 - 2. Zinc Metal Wall Panels: Use panel manufacturer's tile clips.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 54 23

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Adhered TPO single-ply roofing system with heat-welded seams.
 - 2. Roof walkway pads for path of travel to and around roof-mounted equipment.

1.3 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.
- B. Roofing Terminology: See ASTM D 1079 and glossary in 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.
 - 1. 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. FM Approvals: Provide membrane roofing, base flashings, and component materials that comply with requirements, as applicable.
 - 1. Fire Classification: Class A.
 - 2. Windstorm Classification: I-90 wind uplift pressure.
 - 3. Hail Resistance: MH.
- D. Energy Performance:
 - 1. Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products and as follows:
 - a. Roof Reflectance: 0.55 minimum; actual values may exceed this.
 - b. Roof Emittance: 0.75; minimum; actual values may exceed this.

1.5 REFERENCED STANDARDS

- A. American Society of Civil Engineers/Structural Engineering Institute
 - 1. ASCE/SEI 7-2005: Minimum Design Loads for Buildings and Other Structures

- B. ASTM International
 - 1. ASTM C 1177-04: Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 2. ASTM C 1278-03: Specification for Fiber-Reinforced Gypsum Panel.
 - 3. ASTM D 1079-05a: Terminology Relating to Roofing & Waterproofing.
 - 4. ASTM D 6878-03: Specification for Thermoplastic Polyolefin Based Sheet Roofing.
 - 5. ASTM E 108-05: Test Methods for Fire Tests of Roof Coverings.
 - 6. ASTM E 119-05a: Test Methods for Fire Tests of Building Construction and Materials.
 - 7. ASTM E 1980-01: Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- C. Code of Federal Regulations
 - 1. 40 CFR 59, Subpart D-2006: National Volatile Organic Compound Emission Standards for Architectural Coatings
- D. Cool Roof Rating Council (Oakland, CA, 866-465-2523; www.coolroofs.org)
 - 1. CRRC-1-2005: Product Rating Program
- E. FM Global
 - 1. FM Global Loss Prevention Data Sheet 1-28-2005: Design Wind Load
 - 2. FM Global Loss Prevention Data Sheet 1-29-2005: Roof Deck Securement & Above-Deck Roof Components
- F. National Roofing Contractors Association
 - 1. The NRCA Roofing and Waterproofing Manual. 5th ed. 2006.

1.6 ACTION SUBMITTALS

- A. General: Comply with Division 01 Section "Submittal Procedures".
- B. Product Data: For each type of product indicated.
 - 1. For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
 - 2. 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:

ICTC Calexico Intermodal Transit Center

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

07 54 23 - 2

IFB Deliverable

02/01/24

1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Walkway pads or rolls.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 1. Submit evidence of compliance with performance requirements.
- C. 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.
- D. Field quality-control reports.
- E. Maintenance Data: For roofing system to include in maintenance manuals.
- F. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved 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 fasteners for membrane roofing system from same manufacturer as membrane roofing wherever possible.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; 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. Preinstallation Roofing Conference: Conduct conference at Project site.
 1. Meet with Owner, 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.

1.9 DELIVERY, STORAGE & 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. 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.

1.10 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.

1.11 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, substrate board, walkway products, and other components of membrane roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, without monetary limitation, in which Installer 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, substrate board, walkway products, and other components of membrane roofing system.
 - 2. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide [Gaf Everguard] or a comparable product.

2.2 TPO ROOFING MEMBRANE

- A. Fleeceback-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
 - 1. Thickness: 60 mils, nominal.
 - 2. Exposed Face Color: GAF Energy TPO (SRI=88), to meet Solar Reflectance Index requirements; Gray.

2.3 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. Other Adhesives: 250 g/L.
 - g. Single-Ply Roof Membrane Sealants: 450 g/L.
 - h. Non-membrane Roof Sealants: 300 g/L.
 - i. Sealant Primers for Nonporous Substrates: 250 g/L.
 - j. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, of same color as sheet membrane.
- C. Walkway Pads: Non-reinforced, 0.150-inch-thick walkway pads, composed of recycled TPO and EPDM; with slip-resistant textured top surface and a smooth bottom surface
1. Size: 30-inch-wide by 50-foot-long rolls, cut to prevent damming of water, if required.
- D. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, thickness as indicated on Drawings.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Corporation; Dens Deck or a comparable product by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Roof Board Insulation:
 - 1. Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents complying with ASTM C 1289, with square edges.
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Firestone Tapered ISO 95+ Polyiso Insulation or a comparable product by one of the following:
 - a. Atlas EPS; a Division of Atlas Roofing Corporation.
 - b. Atlas Roofing Corporation.
 - c. Carlisle SynTec Incorporated.
 - d. Dyplast Products.
 - e. Firestone Building Products.
 - f. Flex Membrane International Corp.
 - g. GAF.
 - h. Hunter Panels.
 - i. Insulfoam - a division of Carlisle Construction Materials Inc.
 - j. Johns Manville; a Berkshire Hathaway company.
 - k. Rmax, Inc.
 - 3. Provide factory-tapered insulation boards fabricated to a minimum 1/4-inch-per-foot slope as needed only where required to maintain roof slopes. Provide overall average thickness required for roof assembly with R-value of 33.
 - 4. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain as indicated on the Drawings.
- C. Insulation Accessories: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
 - 1. Mechanical Fasteners: Manufacturer's recommended, factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation panels to substrates indicated.
 - 2. Insulation Adhesive: Manufacturer's recommended, single component, moisture cured, foam adhesive, disperse to adhere from a portable pre-pressurized container used to adhere insulation panels to other insulation panels for multi-layer applications.

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.
- 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.

3.3 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. Wherever possible create sumps at roof drains so completed surface slopes to drain, does not restrict flow of water, and transitions smoothly under the clamping ring.
- E. 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 with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- F. 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.

3.4 SUBSTRATE BOARD

- A. Install substrate 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 in each direction. Tightly 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 membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- 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 if required by manufacturer.
- 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. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing if required by manufacturer for 20-year warranty.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.6 SHEET FLASHING AND WALKWAY PAD 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 if required by manufacturer. 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 seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings with compatible caulking or stainless steel worm gear clamps.
- F. Roof Walkway Pad Installation:
 - 1. Install walkway pads in locations as shown on the Drawings.
 - 2. Place walkway pads over the TPO roofing system with the textured side up.
 - 3. Cut the material into lengths that can be easily handled. Lay pads out so that they do not result in ponding water.
 - 4. Heat weld the perimeters of each walkway pad section to the TPO roof membrane using techniques similar to splicing of the TPO roofing system membrane panels.
 - 5. Special attention must be given when welding occurs over roof membrane seams, to assure that a proper weld is achieved, and no damage to the membrane seams occurs.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and 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.

3.8 PROTECTING & 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 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.

END OF SECTION

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. Section Includes:

1. Formed low-slope roof sheet metal fabrications.
 - a. Roof edge flashing (gravel stop).
 - b. Roof edge flashing (gravel stop) with fascia cap.
 - c. Copings.
 - d. Base flashing.
 - e. Counterflashing.
 - f. Flashing receivers.
 - g. Cold pipe roof-penetration flashing.
 - h. Hot pipe roof-penetration flashing.
2. Formed wall sheet metal fabrications.
 - a. Perimeter Foundation Insulation Protection Trim.
3. Formed equipment support flashing.
4. Underlayment Materials:
 - a. Self-Adhering, high-temperature sheet.
5. Miscellaneous materials for sheet metal flashing and trim.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 42 13 "Metal Wall Panels" for materials and installation of sheet metal flashing and trim integral with metal wall panels.
3. Section 07 54 23 "Thermoplastic Polyolefin (TPO) Roofing" for materials and installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 6. Include details of termination points and assemblies.
 - 7. Include details of roof-penetration flashing.
 - 8. Include details of edge conditions, including the following and others as applicable:
 - a. Roof edge flashings.
 - b. Counterflashings.
 - 9. Include details of special conditions.
 - 10. Include details of connections to adjoining work.
 - 11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish.
 - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 - 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For the following:
 - 1. Roof Edge Flashing:
 - a. For each type that is SPRI ES-1 tested.
 - 2. Coping:

- a. For each type that is SPRI ES-1 tested.
- B. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. Shop shall be listed as able to fabricate required details for following:
 - a. Roof Edge Flashings:
 - 1) SPRI ES-1 as tested.
 - b. Copings:
 - 1) SPRI ES-1 as tested.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standards:
 - 1. For Roof Edge Flashings: Comply with requirements indicated in the following publications for dimensions and profiles shown unless more stringent requirements are indicated.

- a. NRCA's "The NRCA Roofing Manual."
 - b. SMACNA's "Architectural Sheet Metal Manual."
- 2. For Copings: Comply with requirements indicated in the following publications for dimensions and profiles shown unless more stringent requirements are indicated.
 - a. NRCA's "The NRCA Roofing Manual."
 - b. SMACNA's "Architectural Sheet Metal Manual."
- C. SPRI Wind Design Standard: Manufacture and install the following materials tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Roof Edge Flashing Design Pressure: As indicated on Structural Drawings.
 - 2. Copings Design Pressure: As indicated on Structural Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316, dead soft, fully annealed; with smooth, flat surface.
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40.
 - 1. Surface Texture:
 - a. Smooth, flat.
 - 2. Surface Finish or Coating:
 - a. Coil-Coated Paint Finishes: Metallic-coated steel sheet prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1) Exposed Surface Finish:
 - a) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish 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.
 - 2) Exposed Surface Color: As indicated on Drawings and Schedules.
 - 3) Concealed Surface Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
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. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products; W. R. Grace & Co.-Conn.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
 - g. Polyguard Products, Inc.; Deck Guard HT.
 - h. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
 - i. SDP Advanced Polymer Products Inc; Palisade SA-HT.
 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone or STP polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- G. Seams: Shop fabricate nonmoving seams with flat-lock seams and seal as follows:
 - 1. Metallic-Coated Steel Sheet:
 - a. With Coil-Coated Painted Finish: Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces of the following:
 - 1. Aluminum-zinc alloy-coated steel sheet.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Overlapped, 4 inches wide.
 - 2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 - 3. Fabricate from the Following Materials:
 - a. Galvanized Steel: Metal thickness as follows for exposed face height of:
 - 1) Up to 8 inches: 0.028 inch thick.
 - 2) Greater than 8 inches up to 10 inches: 0.034 inch thick.
 - 3) Greater than 10 inches up to 16 inches: 0.040 inch thick.
 - b. Aluminum-Zinc Alloy-Coated Steel: Metal thickness as follows for exposed face height of:
 - 1) Up to 8 inches: 0.028 inch thick
 - 2) Greater than 8 inches up to 10 inches: 0.034 inch thick
 - 3) Greater than 10 inches up to 16 inches: 0.040 inch thick
- B. Roof Edge Flashing (Gravel Stop) with Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Overlapped, 4 inches wide.
 - 2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 - 3. Fabricate from the Following Materials:
 - a. Galvanized Steel: Metal thickness as follows for exposed face height of:
 - 1) Up to 8 inches: 0.028 inch thick.
 - 2) Greater than 8 inches up to 10 inches: 0.034 inch thick.

- 3) Greater than 10 inches up to 16 inches: 0.040 inch thick.
- b. Aluminum-Zinc Alloy-Coated Steel: Metal thickness as follows for exposed face height of:
 - 1) Up to 8 inches: 0.028 inch thick.
 - 2) Greater than 8 inches up to 10 inches: 0.034 inch thick.
 - 3) Greater than 10 inches up to 16 inches: 0.040 inch thick.
- C. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
 1. Coping Profile: As indicated on Drawings according to SMACNA's "Architectural Sheet Metal Manual."
 2. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
 3. Fabricate from the Following Materials:
 - a. Galvanized Steel: 0.040 inch thick.
 - b. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
- D. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Galvanized Steel: 0.022 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- F. Flashing Receivers: Fabricate from the following materials:
 1. Galvanized Steel: 0.022 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- G. Cold Pipe Roof-Penetration Flashing: Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- H. Hot Pipe Roof-Penetration Flashing: Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Perimeter Foundation Insulation Protection Trim: Fabricate from the following materials, profile as indicated on Drawings:

ICTC Calexico Intermodal Transit Center

SHEET METAL FLASHING AND TRIM

07 62 00 - 8

IFB Deliverable

02/01/24

1. Stainless Steel: 0.0375 inch (20 gage) thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
 6. Do not use graphite pencils to mark metal surfaces of the following:

- a. Aluminum-zinc alloy-coated steel sheet.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 1. Coat concealed side of flashing and trim fabricated from the following sheet metal(s) with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install following underlayment(s).
 - a. Self-Adhering, high-temperature sheet.
- C. Expansion Provisions:
 1. Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - a. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - b. Use lapped expansion joints only where indicated on Drawings. Apply sealant tape concealed in joint.
 2. Conceal where possible in exposed work.
 3. Locate to minimize possibility of leakage.
 4. Cover and seal anchors as required for a tight installation.
- D. Fasteners:
 1. Size: Use fastener sizes that:
 - a. Penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
 - b. Penetrate other substrates not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
 - c. <Insert size requirement>.
 2. Conceal where possible in exposed work.
 3. Locate to minimize possibility of leakage.
 4. Cover and seal as required for a tight installation.
- E. Seal joints as required for watertight construction.
 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

F. Rivets:

1. Where necessary for strength, rivet field joints if riveting is permitted for shop fabricated joints.
2. Do not rivet soldered joints unless otherwise indicated.
3. Rivets heads exposed to view must closely match color of sheet metal finish.

3.4 ROOF FLASHING INSTALLATION

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

B. Roof Edge Flashing:

1. Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings:

1. Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
 - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
 - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

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

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of anchor and washer at 36-inch centers unless otherwise indicated.

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

3.5 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 ERECTION TOLERANCES

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

3.7 CLEANING AND PROTECTION

- A. Clean the following exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal roof curbs.
 - 2. Metal equipment supports.
 - 3. Metal roof hatches with single leaf lid.
 - 4. Metal safety railings for roof hatches.
 - 5. Metal ladder-assist post for roof hatch access ladder.
 - 6. Pipe supports.
 - 7. Duct supports.
 - 8. Curb-mounted pipe portals.
 - 9. Flashing pipe portals.
 - 10. Preformed flashing sleeves.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with the following to provide a leakproof, weathertight, secure, and noncorrosive installation.
 - 1. Interfacing and adjoining construction.
 - 2. Roofing membrane and base flashing.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 1. Size and location of roof accessories specified in this Section.
 2. Method of attaching roof accessories to roof or building structure.
 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 4. Required clearances.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Gravity Loads:
 1. Roof Curbs: As indicated on Structural Drawings.
 2. Equipment Supports: As indicated on Structural Drawings.
- C. Wind and Seismic Design Criteria: As indicated on Structural Drawings.
- D. Wind-Restraint Performance: As indicated on Structural Drawings.

2.2 METAL ROOF CURBS

- A. Description: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with construction indicated.
 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. AES Industries, Inc.
 - b. Adaptable Air Products.
 - c. Air Balance, Inc.; a division of Mestek, Inc.
 - d. Conn-Fab Sales, Inc.
 - e. Greenheck Fan Corporation.
 - f. LM Curbs.
 - g. Louvers & Dampers; a division of Mestek, Inc.
 - h. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - i. Plenums Incorporated.
 - j. Roof Curb Systems Inc.
 - k. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
 - l. Roof Products, Inc.
 - m. Vent Products Co., Inc.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Metal Material:
- 1. Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.052 inch thick.
- E. Construction:
- 1. Corner Joints: Welded or mechanically fastened and sealed.
 - 2. Curb Profile: Manufacturer's standard with integrally formed deck-mounting flange at perimeter bottom, compatible with roofing system, and as follows:
 - a. At single ply membrane roofs, form curbs with straight metal sides, no cant at deck-mounting flange.
 - b. At built-up non-insulated roofs, form curbs with straight metal sides with integral cant at deck-mounting flange.
 - c. At built-up insulated roofs, form curbs with stepped metal sides with no cant at deck-mounting flange and with integral metal cant at level raised the thickness of roof insulation.
 - d. On ribbed or fluted metal roofs, form curbs with straight metal sides, and form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.

5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2 inch thick glass-fiber board insulation complying with ASTM C 726, nominal density of 3 lbs/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailers:
 - a. Factory-installed wood nailers along top flange of curb, continuous around curb perimeter.
 - b. Material: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches thick.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4 inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 METAL EQUIPMENT SUPPORTS

- A. Description: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with construction indicated.
 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. AES Industries, Inc.
 - b. Adaptable Air Products.
 - c. Air Balance, Inc.; a division of Mestek, Inc.
 - d. Conn-Fab Sales, Inc.
 - e. Curbs Plus, Inc.
 - f. Custom Solution Roof and Metal Products.
 - g. Greenheck Fan Corporation.
 - h. KCC International Inc.
 - i. LM Curbs.
 - j. Louvers & Dampers; a division of Mestek, Inc.

- k. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - l. Pate Company (The).
 - m. Plenums Incorporated.
 - n. Roof Curb Systems Inc.
 - o. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
 - p. Roof Products, Inc.
 - q. Thybar Corporation.
 - r. Vent Products Co., Inc.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Metal Material:
- 1. Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.052 inch thick.
- E. Construction:
- 1. Corner Joints: Welded or mechanically fastened and sealed.
 - 2. Curb Profile: Manufacturer's standard with integrally formed structure-mounting flange at perimeter bottom, compatible with roofing system, and as follows:
 - a. At single ply membrane roofs, form curbs with straight metal sides, no cant at structure-mounting flange.
 - b. At built-up non-insulated roofs, form curbs with straight metal sides with integral cant at structure-mounting flange.
 - c. At built-up insulated roofs, form curbs with stepped metal sides with no cant at structure-mounting flange and with integral metal cant at level raised the thickness of roof insulation.
 - d. On ribbed or fluted metal roofs, form curbs with straight metal sides, and form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 4. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
 - 5. Insulation: Factory insulated with 1-1/2 inch thick glass-fiber board insulation complying with ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 6. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
 - 7. Nailers:

- a. Factory-installed continuous wood nailers 3-1/2 inches wide on top flange of equipment supports, continuous around support perimeter.
 - b. Material: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- 8. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
 - 9. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4 inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
 - 10. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.

2.4 METAL ROOF HATCHES WITH SINGLE LEAF LID

- A. Description: Metal roof-hatch units with one lid and insulated curbs, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, with construction indicated.
 - 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. Acudor Products, Inc.
 - b. AES Industries, Inc.
 - c. Babcock-Davis.
 - d. Bilco Company (The).
 - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - f. KCC International Inc.
 - g. Lexcor; a division of Luxsuco corp.
 - h. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - i. Nystrom, Inc.
 - j. O'Keeffe's Inc.
- B. Single-Leaf Lid Size: As indicated on Drawings.
- C. Loads: Minimum 40 lbf/sq. ft. external live load and 20 lbf/sq. ft. internal uplift load.
 - 1. Dome Glazing: Minimum 40 lbf/sq. ft. external live load and 20 lbf/sq. ft. internal uplift load.
- D. Metal Material:
 - 1. Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet.
 - a. Thickness: Manufacturer's standard thickness for hatch size indicated.
 - b. Finish for Factory Painted Hatches:
 - 1) Either of following:

- a) Two-coat fluoropolymer.
 - b) Baked enamel or powder coat.
 - 2) Color for Factory Painted Curbs: As selected by Architect from manufacturer's full range.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Construction:
 - 1. Corner Joints: Welded or mechanically fastened and sealed.
 - 2. Curb Type:
 - a. Insulated single-walled.
 - b. Insulated double-walled with manufacturer's standard curb liner of same material and finish as metal curb.
 - 3. Curb Profile: Manufacturer's standard with integrally formed deck-mounting flange at perimeter bottom, compatible with roofing system, and as follows:
 - a. At single ply membrane roofs, form curbs with straight metal sides, no cant at deck-mounting flange.
 - b. At built-up non-insulated roofs, form curbs with straight metal sides with integral cant at deck-mounting flange.
 - c. At built-up insulated roofs, form curbs with stepped metal sides with no cant at deck-mounting flange and with integral metal cant at level raised the thickness of roof insulation.
 - d. On ribbed or fluted metal roofs, form curbs with straight metal sides, and form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 4. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 5. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
 - 6. Insulation:
 - a. 1 inch thick, cellulosic-fiber board complying with ASTM C 208, Type II, Grade 1, with 2.78 R-Value according to ASTM C1363.
 - b. 1 inch thick, glass-fiber board complying with ASTM C 726, nominal density of 3 lb/cu. ft., with 4.3 R-Value according to ASTM C1363.
 - c. 2 inch thick, polyisocyanurate board complying with ASTM C 1289, with 12.0 R-Value according to ASTM C1363.
 - 7. Nailer:
 - a. Factory-installed wood nailer continuous around hatch perimeter.

- b. Material: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- 8. Hatch Lid:
 - a. Opaque Lid: Insulated, double walled type with manufacturer's standard metal liner of same material and finish as outer metal lid.
- G. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt or pintle type hinge system, and padlock hasps inside and outside.
 - 1. Provide two-point latch on lids larger than 84 inches.
 - 2. Provide remote-control operation.

2.5 METAL SAFETY RAILING SYSTEM

- A. Provide safety railing system(s) at roof hatch(es) where indicated on Drawings.
- B. Description: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
 - 1. Height: 42 inches above finished roof deck.
 - 2. Posts, Rails, and Supplementary Framing Material: Manufacturer's standard metal.
 - 3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
 - 4. Passway Barrier:
 - a. Chain Type: Galvanized proof coil chain with quick link on fixed end.
 - b. Self-Latching Gate Type: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 - 5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 - 6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 - 7. Fabricate joints exposed to weather to be watertight.
 - 8. Fasteners: Manufacturer's standard, finished to match railing system.
 - 9. Painted Finish: Manufacturer's standard.
 - a. Color: As selected by Architect from manufacturer's full range.

2.6 METAL LADDER-ASSIST POST

- A. Provide ladder-assist post(s) at roof hatch(es) where indicated on Drawings.
- B. Description: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Either of following:
 - a. Steel, painted with manufacturer's standard baked enamel or powder coat.
 - 1) Color: Safety yellow.
 - b. Steel, hot dipped galvanized.
 - c. Stainless steel, mill finish.
 - d. Aluminum with mill finish.
4. Post: Minimum 1-1/2 inch o.d. and maximum 1-5/8 inch o.d. round or square, metal pipe or tube.

2.7 PIPE SUPPORTS

- A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2 inch diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
 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. Miro Industries.
 - b. Pate Company (The).
 - c. PHP Systems/Design.
 - d. Thaler Metal Industries Ltd.

2.8 DUCT SUPPORTS

- A. Description: Extruded-aluminum, urethane-insulated supports, 2 inches in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
 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. Thaler Metal Industries Ltd.
 2. Finish: Manufacturer's standard.

2.9 CURB-MOUNTED PIPE PORTALS

- A. Description: Insulated roof-curb units with construction indicated and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.
 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. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
- B. Construction:
- 1. Corner Joints: Welded or mechanically fastened and sealed.
 - 2. Curb Profile: Manufacturer's standard with integrally formed structure-mounting flange at perimeter bottom, compatible with roofing system, and as follows:
 - a. At single ply membrane roofs, form curbs with straight metal sides, no cant at structure-mounting flange.
 - b. At built-up non-insulated roofs, form curbs with straight metal sides with integral cant at structure-mounting flange.
 - c. At built-up insulated roofs, form curbs with stepped metal sides with no cant at structure-mounting flange and with integral metal cant at level raised the thickness of roof insulation.
 - d. On ribbed or fluted metal roofs, form curbs with straight metal sides, and form deck-mounting flange at perimeter bottom to conform to roof profile.

2.10 FLASHING PIPE PORTALS

- A. Description: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.
- 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. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.

2.11 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.
- 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. Custom Solution Roof and Metal Products.
 - b. Thaler Metal Industries Ltd.
 - 2. Metal: Aluminum sheet, 0.063 inch thick.
 - 3. Diameter: As indicated on Drawings.
 - 4. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
- 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. Custom Solution Roof and Metal Products.
 - b. Milcor; Commercial Products Group of Hart & Cooley, Inc.

- c. Thaler Metal Industries Ltd.
2. Metal: Aluminum sheet, 0.063 inch thick.
3. Height: 13 inches.
4. Diameter: As indicated on Drawings.
5. Finish: Manufacturer's standard.

2.12 METAL MATERIALS

A. Metallic-Coated Steel Sheet:

1. Provide either of following unless indicated otherwise:
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation and mill phosphatized for field painting where indicated.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.
2. Finish for Factory Painted Metal:
 - a. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1) Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
 - 2) Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of wash coat and prime coat, with a minimum total dry film thickness of 0.5 mil.
 - b. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

- B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Steel Shapes: ASTM A 36/A 36M, hot-dipped galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.13 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Underlayment:

1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.14 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof accessories according to manufacturer's written instructions.
 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 3. Bed flanges in thick coat of setting bed material where required by manufacturers of roof accessories for waterproof performance.
 - a. On non-asphaltic roofing use elastomeric sealant, butyl sealant, or other sealant material recommended by roofing membrane manufacturer.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 2. Attach safety railing system to roof-hatch curb.
 3. Attach ladder-assist post according to manufacturer's written instructions.
- F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- G. Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- H. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- I. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.
- 3.3 REPAIR AND CLEANING**
- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 84 13
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. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 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. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Grabber Construction Products.
 - d. Hilti, Inc.
 - e. HOLDRITE.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal.
 - i. Specified Technologies, Inc.
 - j. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping 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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

- B. Install forming 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.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping 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 that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 07 84 43
JOINT 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. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 - 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. 3M Fire Protection Products.
 - b. Grabber Construction Products.
 - c. Hilti, Inc.
 - d. Thermafiber, Inc.; an Owens Corning company.
 - e. Tremco, Inc.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions 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 of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately 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 elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping 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.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping 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

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Latex joint sealants.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Joint-sealants.
 - 2. Joint sealant backing materials.
 - 3. Indicate VOC content.
- B. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
 - 1. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - a. Joint-sealant location and designation.
 - b. Manufacturer and product name.
 - c. Type of substrate material.
 - d. Proposed test.
 - e. Number of samples required.
 - 2. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- B. Field Quality-Control Submittals:
 - 1. Field-Adhesion-Test Reports: For each sealant application tested.

- C. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
 - 1. Manufacturers' special warranties.
 - 2. Installer's special warranties.

1.7 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Authorized representative who is trained and approved by manufacturer.
 - 2. Testing Agency: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.8 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content: Sealants and sealant primers shall comply with the following:
 - 1. Architectural sealants shall have a VOC content of 250 g/L or less.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 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. Adfast.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Sika Corporation; Joint Sealants.

2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, available products offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. Pecora Corporation AC-20+.
 - d. Tremco Incorporated; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 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. Adfast.
 - b. Alcot Plastics Ltd.

- c. Construction Foam Products; a division of Nomaco, Inc.
 - d. Master Builders Solutions.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Unglazed surfaces of ceramic tile.

3. .Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at in accordance with Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

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

3.6 JOINT-SEALANT SCHEDULE

- A. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement:
 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces:
 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

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 hollow-metal work for the following:
 - 1. Interior doors and frames complying with SDI Standards.
 - 2. Exterior doors and frames complying with SDI Standards.
 - 3. Louvers for doors.
- B. Related Requirements:
 - 1. Section 08 71 00 - Door Hardware for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8 and as follows:

STEEL SHEET THICKNESSES		
Gage (MSG)	Minimum Uncoated Thickness	
	Inch	Mils
20	0.032	32
18	0.042	42
16	0.053	53
14	0.067	67
12	0.093	93
10	0.123	123
7	0.167	167

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of 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 Verification:
1. For the following, prepare Samples approximately 8 by 10 inches 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. Door Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- D. 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 final Door Hardware Schedule.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 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. Apex Industries, Inc.

2. Ceco Door; ASSA ABLOY.
3. Commercial Door & Hardware Inc.
4. Daybar Industries, Ltd..
5. Deansteel Manufacturing Company, Inc..
6. DKS Steel Door & Frame System, Inc.
7. Gensteel Doors Inc.
8. Greensteel Industries, Ltd.
9. HMF Express, LLC.
10. Hollow Metal Inc.
11. Karpen Steel Custom Doors & Frames.
12. Mesker Door Inc.
13. MPI Group, LLC (The).
14. National Custom Hollow Metal Door & Frames.
15. North American Door Corp.
16. Premier Products, Inc.
17. Republic Doors and Frames.
18. Steelcraft; an Ingersoll-Rand company.
19. Steward Steel Door & Frame Division.
20. Trillium Steel Doors Limited.

- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Frame Construction:
1. Face welded unless indicated otherwise.
 2. Full profile welded for frames installed in high humidity spaces including rooms containing showers and water spray equipment.
- C. Extra-Heavy-Duty 1-3/4 inch Thick Doors with Frames, Ungalvanized: SDI A250.8, Level 3.
1. Locations: Where indicated in the Door and Frame Schedule.
 2. Locations as follows:
 - a. interior, dry areas only.
 3. Physical Performance: Level A according to SDI A250.4.
 4. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
 - b. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.053 inch.
 - c. Edge Construction: Model 2, Seamless.
 - d. Core:
 - 1) Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
5. Frames:
- a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch.
6. Exposed Finish: Prime.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Frame Construction:
 - 1. Full profile welded unless indicated otherwise.
- C. Extra-Heavy-Duty 1-3/4 inches Doors with Frames, Galvanized: SDI A250.8, Level 3.
 - 1. Locations: Where indicated in the Door and Frame Schedule.
 - 2. Locations as follows:
 - a. All exterior doors and door exposed to Wash Bay.
 - 3. Physical Performance: Level A according to SDI A250.4.
 - 4. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - c. Edge Construction: Model 2, Seamless.
 - d. Core:
 - 1) Polystyrene.
 - 5. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - 6. Exposed Finish: Prime.

2.4 LOUVERS

- A. Sightproof Louvers, Ungalvanized: Stationary louvers which comply with SDI 111C, with blades or baffles constructed with inverted-V or inverted-Y blades formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
 - 1. Locations: Where indicated in the Door and Frame Schedule.

2. Exposed Finish: Matching door panel.

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 thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, 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 height adjustment. Terminate bottom of frames at finish floor surface.

2.6 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.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z 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. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, 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 maximum flame-spread and smoke-developed 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, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 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 metal thickness. 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. Hollow-Metal Doors:
1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. 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. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 5. Head Anchors: Two anchors per head for frames more than 42 inches wide.
 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted 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 glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

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. 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. 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 for doors and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 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. 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.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be 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 power-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. 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.
 - 5. 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
- 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 o.c. and not more than 2 inches 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. Touchup Painting:
 - 1. Prime-Coated Surfaces: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION

SECTION 08 31 13
ACCESS 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. Access doors and frames for walls and ceilings.

- B. Schedule: Provide access door and frames at following installation locations:

- 1. All access doors and frames to be stainless steel in wet environments including, but not limited to toilet rooms, shower rooms, and wash bay.

- 2. Interior Non-Fire-Rated Walls:

- a. Equipment Accessed: Piping Shut-Off Valves (See Note 2).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.

- 2) Nominal Size: 12 inches square.

- b. Equipment Accessed: Clean-Outs (See Note 2).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.

- 2) Nominal Size: 12 inches square.

- 3. Interior Non-Fire-Rated Gypsum Board Ceilings:

- a. Equipment Accessed: Manual Volume Dampers (See Note 3).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.

- 2) Nominal Size: 18 inches square.

- b. Equipment Accessed: VAV Terminal Units (See Note 3).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.

- 2) Nominal Size: 18 inches square.

- c. Equipment Accessed: Combination Fire/Smoke dampers (See Note 3).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.

- 2) Nominal Size: 18 inches square.

- d. Equipment Accessed: Piping Shut-Off Valves (See Note 2).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.

- 2) Nominal Size: 12 inches square.

- 3) Provide lockable door where indicated on plans.

- e. Equipment Accessed: Clean-Outs (See Note 2).

- 1) Type: Flush Access Doors and Frames with Exposed Flanges.
- 2) Nominal Size: 12 inches square.
- f. Equipment Accessed: Fan Coil Units.
 - 1) Type: Flush Access Doors and Frames with Exposed Flanges.
 - 2) Nominal Size: 24 inches square.
4. Notes:
 - a. Note 1: In fire-resistance rated building elements provide access doors and frames with fire rating not less than that of adjacent construction.
 - b. Note 2: Reference Plumbing Drawings.
 - c. Note 3. Reference Mechanical HVAC Drawings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 1. Include plans, elevations, sections, details, and attachments to other work.
 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- E. Closeout: Deliver keys properly tagged to Owner.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- 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. Acudor Products, Inc.
 2. Babcock-Davis.
 3. Jensen Industries; Div. of Broan-Nutone, LLC.
 4. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 5. Karp Associates, Inc.
 6. Larsen's Manufacturing Company.
 7. Metropolitan Door Industries Corp.
 8. MIFAB, Inc.
 9. Milcor Inc.

10. Nystrom, Inc.
- B. Source Limitations: Obtain all types of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Exposed Flanges:
 1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 2. Locations: Wall and ceiling.
 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
 - a. Finish: Factory prime.
 4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage.
 - a. Finish: Factory prime.
 5. Frame Material: Same material, thickness, and finish as door.
 6. Hinges: Manufacturer's standard.
 7. Hardware:
 - a. Latch:
 - b. Lock: Cylinder.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- E. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- F. Frame Anchors: Same type as door face.
- G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 3. Provide mounting holes in frames for attachment of units to metal or wood framing.
 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.4 FINISHES

- 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: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil for topcoat.
- E. Stainless-Steel Finishes:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Directional Satin Finish: No. 4. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.
- F. Aluminum Finishes:
1. Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates 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. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

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

END OF SECTION

SECTION 08 51 13
ALUMINUM WINDOWS

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 aluminum windows for exterior locations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
 - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
 - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
 - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
 - 1. Include plans, elevations, sections, hardware, accessories, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 1. Minimum Performance Class: LC.
 2. Minimum Performance Grade: 25.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K).
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.23.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, 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 joint sealants, 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: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

2.3 ALUMINUM WINDOWS

- 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. All Seasons Window & Door Mfg.; All Seasons Commercial Division, Inc.
 2. All Weather Architectural Aluminum.
 3. Alumatherm.
 4. Arcadia, Inc.
 5. EFCO Corporation.
 6. Oldcastle Building Envelope.
 7. TRACO.
 8. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
 9. Winco Manufacturing Co.
 10. YKK AP America Inc.
- B. Types: Provide the following types in locations indicated on Drawings:
 1. Casement: Outswing.
 2. Projected, awning.
 3. Horizontal sliding.
 4. Fixed.

- C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- D. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.
 - 1. Kind: Fully tempered.
- E. Insulating-Glass Units: ASTM E2190.
 - 1. Glass: ASTM C1036, Type 1, Class 1, q3.
 - a. Tint: Clear.
 - b. Kind: Fully tempered.
 - 2. Lites: As indicated on Drawings.
 - 3. Filling: Fill space between glass lites with argon.
 - 4. Low-E Coating: Sputtered on second surface.
- F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
 - 1. Dual Glazing System:
 - a. Interior Lite: Glass.
 - b. Exterior Lite: Glass.
- G. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
 - 1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations.
- H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

- A. Dividers (False Muntins): Provide extruded-aluminum divider grilles in designs indicated for each sash lite.
 - 1. Type: Permanently located between insulating-glass lites.
 - 2. Pattern: As indicated on Drawings.
 - 3. Profile: As selected by Architect from manufacturer's full range.

- B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- C. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- E. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- F. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weatherstrip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" 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: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic or polyester enamel primer/topcoat system complying with AAMA 2603, medium gloss.
2. Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 3. Water-Resistance Testing:

- a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
- b. Allowable Water Infiltration: No water penetration.
- 4. Testing Extent: One window of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
- 5. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

SECTION 08 56 19
TICKET WINDOWS

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: Ticket windows.
- B. Related Sections: Section 08 80 00 - Glazing.

1.3 SUBMITTALS

- A. Samples:
 - 1. Aluminum Finish: 3-inch square or manufacturer's standard size aluminum sheet with specified finish and color.
- B. Product Data: Manufacturer's specifications, installation instructions, standard details, including fabrication, finishing, hardware and other components of the work.
- C. Shop Drawings:
 - 1. Include typical unit elevation at 1-inch scale and detail sections of each typical composite member.
 - 2. Include window schedule, window elevations, sections and details, and multiple window assembly details.
 - 3. Details of ticket window counter.

1.5 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within one year beginning from the date of Substantial Completion. Failures include, but are not limited to, the following:
 - 1. Failure to meet performance requirements.
 - 2. Structural failures including excessive deflection.
 - 3. Faulty operation of movable sash and hardware.
 - 4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver window units and accessories in manufacturer's original packaging, clearly identified with manufacturer's name and type of product, finish, and installation location.
- B. Store in the original packaging, indoors, in an upright position, protected from damage.
- C. Handle in a manner to prevent twisting and other damage.
- D. Conform to additional requirements of the manufacturer.

PART 2 - PRODUCTS

2.1 TICKET WINDOWS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Creative Industries Bullet Resistant Ticket Window TIK 2448** or comparable product.
- B. Size: 24 inches by 48 inches.
- C. Frames: Aluminum clamp-on adjustable frame.
 - 1. Material: Aluminum; comply with requirements of AAMA/WDMA/CSA 101/I.S.2/A440-05, 6063-T5 extruded aluminum.
 - 2. Finish: Factory applied finish to aluminum components after fabrication.
 - 3. Color: Dark bronze anodized aluminum.
- D. Glazing: Bullet resistant.
 - 1. BR Glass Level: As selected by Architect.
- E. Talk Thru: Two-way voice amplified bullet resistant.
- F. Counter Top and Drawer Combination: Stainless steel; provide weatherstripping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that openings conform with dimension and tolerances shown, and that surfaces that will be in contact with frames are free of debris.
- B. Proceed only when conditions are satisfactory.

3.2 INSTALLATION

- A. Install window units as shown on Drawings and according to manufacturer's written instructions.
- B. Set units plumb, level, and true to line, without warp or rack of frames.
- C. Anchor securely in place by fastening perimeter frame to wall framing.
- D. Dissimilar Metals: Separate aluminum from steel and other dissimilar metals with plastic separators to prevent galvanic action.

3.3 CLEANING

- A. After installation, clean metal and glass surfaces.

END OF SECTION

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.
 - 4. UL 305 - Panic Hardware.
 - 5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals

that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Proof of Compliance: (California located Projects): Provide a list of product(s) containing chemicals known to cause cancer or reproductive toxicity as defined by the Office of Environmental Health Hazard Assessment (OEHHA) under Proposition 65 (CA Code of Regulations, Title 27, Section 27001). The list includes the specific chemical(s), if the chemical will be exposed to consumers, the means of warning, and an illustration of the label.
- E. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware 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.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural

Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Ten years for extra heavy duty cylindrical (bored) locks and latches.
 - 3. Twenty five years for manual overhead door closer bodies.

1.8 MAINTENANCE SERVICE

- 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 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01,

Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 5. Manufacturers:
 - a. Bommer Industries (BO).
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Match Facility Standard.
- D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

- E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
 - 1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 - 2. Manufacturers:
 - a. Corbin Russwin (RU) - Access 3 AP.
 - b. Sargent (SA) - Degree DG1.
- F. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. New System: Key locks to a new key system as directed by the Owner.
- G. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
 - 4. Construction Control Keys (where required): Two (2).
 - 5. Permanent Control Keys (where required): Two (2).
- H. Construction Keying: Provide temporary keyed construction cores.
- I. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.4 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 - 1. Where specified, provide status indicators with highly reflective color and wording for "locked/unlocked" or "vacant/occupied" with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the

indicator status. Indicator window size to be a minimum of 2.1" x 0.6" with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.

2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.
 - c. Schlage (SC) - L9000 Series.

B. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.

1. Vertical Impact: Exceed 100 vertical impacts (20 times ANSI/BHMA A156.2 requirements).
2. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
3. Locks are to be non-handed and fully field reversible.
4. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - CL3300X Series.
 - b. Sargent Manufacturing (SA) - 10X Line.
 - c. Schlage (SC) - ND Series.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Manufacturers:
 - a. LCN Closers (LC) - 4040 Series.
 - b. Norton Door Controls (NO) - 7500 Series.
 - c. Sargent Manufacturing (SA) - 351 Series.

2.8 ARCHITECTURAL TRIM

- A. Door Protective Trim
1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
 6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
1. Manufacturers:

- a. Hiawatha, Inc. (HI).
- b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
 - 2. Reese Enterprises, Inc. (RE).

2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- 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. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.7 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
1. Quantities listed are for each pair of doors, or for each single door.
 2. The supplier is responsible for handing and sizing all products.
 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

Hardware Sets

Set: 1.0

Doors: [103](#), [107](#), [110](#)

Description: Ext Sgl, Storeroom

3 Hinge, Full Mortise	TA2314 (NRP)	US32D	MK
1 Storeroom Deadbolt Lock	64 8251 LNL	US32D	SA
1 Permanent Core	DG1 6300	US15	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	441H	US26D	RO
1 Threshold	Per Sill Detail		PE
1 Gasketing (Head)	2891AS		PE
1 Gasketing (Jambs)	290AS		PE
1 Rain Guard	346C (Omit @ Overhang)		PE
1 Sweep	18062CNB		PE

Set: 2.0

Doors: [106](#)

Description: Ext Sgl, Privacy

3 Hinge, Full Mortise	TA2314 (NRP)	US32D	MK
1 Institutional Privacy Lock	V21 64 8267 LNL	US32D	SA
1 Permanent Core	DG1 6300	US15	SA
1 Surface Closer	7500	689	NO
1 Mop Plate	K1050 6" High CSK BEV	US32D	RO
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Door Stop	441H	US26D	RO
1 Threshold	Per Sill Detail		PE
1 Gasketing (Head)	2891AS		PE
1 Gasketing (Jambs)	290AS		PE
1 Rain Guard	346C (Omit @ Overhang)		PE
1 Sweep	18062CNB		PE

Set: 3.0

Doors: 104

Description: Int Sgl, Storeroom, Closer

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Storeroom/Closet Lock	64 10XG04 LL	US26D	SA
1 Permanent Core	DG1 6300	US15	SA
1 Surface Closer	7500	689	NO
1 Wall Stop	403	US26D	RO
3 Silencer	608-RKW		RO

Set: 4.0

Doors: 105

Description: Int Sgl, Office, No Closer

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Entry/Office Lock	64 10XG05 LL	US26D	SA
1 Permanent Core	DG1 6300	US15	SA
1 Wall Stop	403	US26D	RO

ICTC Calexico Intermodal Transit Center

IFB Deliverable

DOOR HARDWARE

08 71 00 - 12

02/01/24

3 Silencer	608-RKW		RO
------------	---------	--	----

Set: 5.0

Doors: 101

Description: Int Sgl, Intruder, Closer

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Classroom Security Lock	64 10XG38 LL	US26D	SA
2 Permanent Core	DG1 6300	US15	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Wall Stop	403	US26D	RO
3 Silencer	608-RKW		RO

Set: 6.0

Doors: 102, 108, 109

Description: Int Sgl, Privacy

3 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Privacy Lock	10XU65 LL	US26D	SA
1 Surface Closer	7500	689	NO
1 Mop Plate	K1050 6" High CSK BEV	US32D	RO
1 Kick Plate	K1050 10" High CSK BEV	US32D	RO
1 Wall Stop	403	US26D	RO
1 Gasketing	S88BL		PE

Set: 7.0

Doors: 111

1	Hardware by Gate Supplier		OT
---	---------------------------	--	----

END OF SECTION

ICTC Calexico Intermodal Transit Center

IFB Deliverable

DOOR HARDWARE

08 71 00 - 13

02/01/24

SECTION 08 80 00

GLAZING

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. Glass for the following:
 - a. Doors.
 - b. Interior borrowed lites.
 - c. Storefront framing.
 - 2. Glazing sealants and accessories.
 - 3. Monolithic Glass Units: See end of Section for detailed glass schedule.
 - a. GL-2: Clear annealed float glass.
 - 4. Insulating Glass Units: See end of Section for detailed glass schedule.
 - a. GL-1: Low-E-coated, tinted insulating glass.
- B. Related Requirements:
 - 1. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts"

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product; 12 inches square.
 1. Insulating glass.
 2. Clear glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 1. Installer.
- B. Product Certificates: For glass.
- C. Product Test Reports: For the following, for tests performed by a qualified testing agency:
 1. Insulating glass.
 2. Glazing sealants; provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 1. Install glazing in mockups to match glazing systems required for Project.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
 1. Oldcastle BuildingEnvelope.
 2. Pilkington North America Inc.
 3. PPG Industries, Inc.
 4. Saint-Gobain Corporation.
 5. Trulite Glass & Aluminum Solutions.
 6. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: "Glazing Manual."

2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling:
1. Where safety glazing is indicated, permanently mark glazing with certification label of one of the following:
 - a. SGCC.
 - b. Another certification agency acceptable to authorities having jurisdiction.
 - c. Manufacturer.
 2. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm.
- D. Strength:
1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article.
 2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article.
 3. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

2.5 GLAZING SEALANTS

- A. General:
1. Compatibility: Compatible with one another and with other materials they contact, including glass products, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Application Limitations: As indicated.
 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Application Limitations:
 - a. Not for use at expansion joints.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Application Limitations:
 - a. Not for use at expansion joints.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Application Limitations:
 - a. Interior exposure only.
 - b. Not for use at expansion joints.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Butt-Glazed Lite: Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Lites with Exposed Edges or Corners: Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.

- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 MONOLITHIC GLASS SCHEDULE

- A. Glass Type 1: Clear annealed float glass.
 - 1. Minimum Thickness: As indicated on Drawings.
 - 2. Safety glazing required.

END OF SECTION

SECTION 08 91 19
FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed metal louvers.

1.3 Related Requirements:

- A. Division 07 Section "Joint Sealants" for sealants installed in perimeter joints between fixed louver frames and adjoining construction.
- B. Division 07 Section "Sheet Metal and Flashing" for flashing.
- C. Division 23 Sections for ductwork connected to louvers.

1.4 DEFINITIONS

- A. Louver Terminology: Refer to AMCA Publication 501-85 for definitions of terms for metal louvers not otherwise defined in this section or referenced standards.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design, engineer, fabricate, and install fixed metal louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors:
 - 1. Wind Load: Uniform pressure (velocity pressure) of 35 psf acting inwards and 48 psf acting outwards.
 - 2. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.
 - a. Temperature Change (Range): 100 deg F (55.5 deg C).
- B. Air Performance, Water Penetration, and Air Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to Air Movement and Control Association (AMCA) Standard 500.
- C. Airborne Sound Transmission Loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer's stock units according to ASTM E 90.

1.6 SUBMITTALS

- A. Product data for each product indicated.

- B. Shop drawings of fixed louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.
 - 1. Where installed products are indicated to comply with certain structural design loadings, include structural computations, material properties, and other information needed for structural analysis which has been prepared by, or under the supervision of, a qualified professional engineer.
- C. Samples for verification purposes of each type of metal finish required, prepared on 6-inch square metal samples of same thickness and alloy indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.
- D. Product test reports evidencing compliance of units with performance requirements indicated.
- E. Product certificates signed by fixed louver manufacturers certifying that their products which comply with Project requirements are licensed to bear AMCA Seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.
- F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience.

1.7 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain fixed louvers from a single source where alike in one or more respects with regard to type, design, and factory-applied color finish.
- B. Qualify welding processes and welding operators in accordance with D1.2 "Structural Welding Code - Aluminum" and D1.3 "Structural Welding Code - Sheet Steel."
- C. Certify that each welder employed in unit of Work of this section has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 - 1. Testing for recertification is Contractor's responsibility.
- D. Engineer Qualifications: Professional engineer licensed to practice in the State of California and experienced in providing engineering services of the kind indicated which has resulted in the successful installation of fixed louvers similar in material, design, and extent to that indicated for this Project.
- E. SMACNA Standard: Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Check actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabrication of fixed louvers without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.01 FIXED LOUVERS

- 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. Airolite Company, LLC.
 2. Airstream Products, Division of Penn Ventilator Co., Inc.
 3. American Warming and Ventilating, Inc.
 4. Arrow United Industries, Division of Mestek, Inc.
 5. Construction Specialties, Inc.
 6. Industrial Louvers Inc.
 7. Nystrom, Inc.
 8. Ruskin Company.

2.02 MATERIALS

- A. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer to produce required finish.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- C. Fasteners: Of same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.
1. Use types, gages, and lengths to suit unit installation conditions.
 2. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Anchors and Inserts: Of type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.
- E. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.03 FABRICATION

- A. General: Fabricate fixed louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
- B. Preassemble fixed louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- 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 size indicated with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.
- E. Include supports, anchorages, and accessories required for complete assembly.

- F. Provide vertical mullions of type and at spacing indicated but not further apart than recommended by manufacturer, or 72 inches o.c., whichever is less. At horizontal joints between fixed louver units provide horizontal mullions except where continuous vertical assemblies are indicated.
- G. Provide sill extensions and loose sills made of same material as fixed louver, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.
- H. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated, or size of fixed louver assembly makes bolted connections between frame members necessary:
 - 1. With fillet welds, concealed from view.

2.04 FIXED EXTRUDED ALUMINUM WALL LOUVERS

- A. Horizontal Drainable Fixed Blade Louvers: Extruded aluminum frames and louver blades, complying with the following requirements:
 - 1. Louver Depth: 4 inches.
 - 2. Frame Type: Channel flange.
 - 3. Frame Thickness: 0.081 inch.
 - 4. Louver Blade Thickness: 0.081 inch.
 - 5. Louver Blade Profile: Plain blade with no center baffle.
 - 6. Louver Blade Angle: 37.5 degrees.
 - 7. Louver Blade Spacing: 5 inches, nominal.
 - 8. Performance Requirements: As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:
 - a. Louver Free Area: Not less than **[54 percent]**.
 - b. Static Pressure Loss: Not more than 0.14 inch water gage at an airflow of 810 fpm free area intake velocity.
 - c. Water Penetration: Not more than 0.02 oz. per sq. ft. of free area at an airflow of 855 fpm free area velocity when tested for 15 minutes.
 - 9. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.05 SCREENS

- A. General: Provide each exterior fixed louver units with louver screens complying with the following requirements:
 - 1. Screen Location: Interior face, unless otherwise indicated.
 - 2. Screening Type: Bird screening, unless otherwise indicated.
- B. Secure screens to fixed louver frames with stainless steel machine screws, spaced at each corner and at 12 inches o.c. between.
- C. Fixed Louver Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:
 - 1. Metal: Same kind and form of metal as indicated for fixed louver frames to which screens are attached.

- a. Reinforce extruded aluminum screen frames at corners with clips.
 - 1. Finish: Same finish as louver frames to which louver screens are attached.
 - 2. Type: Non-rewireable U-shaped frames for permanently securing screen mesh.
- D. Screening for Aluminum Fixed Louvers: Fit aluminum fixed louver frames with screening covering louver openings and complying with the following requirements:
- 1. Bird Screening: 1/2-inch square mesh formed with 0.063-inch diameter aluminum wire.

2.06 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish fixed louvers after assembly.

2.07 ALUMINUM FINISHES

- A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating. Apply baked enamel complying with paint manufacturer's specifications for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic enamel system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.
 - a. Color: As selected from manufacturer's standard range.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, and instructions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.02 INSTALLATION

- A. Locate and place fixed louver units plumb, level, and in proper 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 operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

- F. Install concealed gaskets, flashings, joint fillers, and insulation, as fixed louver installation progresses where required to make louver joints weathertight. Comply with Division 07 Section "Joint Sealers" for sealants applied during installation of fixed louvers.

3.03 ADJUSTING AND PROTECTION

- A. Protect fixed louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by fixed louver manufacturer. Remove protective covering at time of Substantial Completion.
- B. Restore fixed louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Architect, remove damaged units and replace with new units.
 - 1. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.04 CLEANING

- A. Periodically clean exposed surfaces of fixed louvers which are not protected by temporary covering to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior partitions and soffits clad with the following:
 - a. Gypsum board.
 - 2. Conventional and grid suspension systems for interior ceilings clad with the following:
 - a. Gypsum board.
- B. Components used with fire-resistance-rated head of wall systems (other than top metal track assembly) are specified in Section 07 84 43 "Joint Firestopping."
- C. Contractor's Discretion:
 - 1. Steel Framing: Provide steel studs and track fabricated from conventional steel sheet or embossed, high strength steel sheet.
 - 2. Partition Head of Wall Systems:
 - a. For fire-resistance-rated head of wall systems provide joint firestopping utilizing slip-type head joints of any type indicated or firestop track of any type indicated, except:
 - 1) Where head of wall is exposed to view, provide joint firestopping specified for exposed locations only.
 - b. For non-fire-resistance-rated head of wall systems provide slip-type head joints of any type indicated, except:
 - 1) Where head of wall is exposed to view, provide slip-type head joints specified for exposed locations only.
 - 3. For Metal Suspension Framing: Provide either of following:
 - a. Metal framing fabricated from conventional sheet steel.
 - b. Metal framing fabricated from embossed, high strength sheet steel.
 - c. Grid suspension system.
- D. Related Requirements:
 - 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs, floor joists, and roof rafters and ceiling joists.

1.3 DEFINITIONS

- A. Partition types are indicated on Drawings.
- B. Walls: In this Section the term "walls" is synonymous with the term "partition walls" or "partitions."
- C. Composite Partition Assemblies: Clad continuously full height on both sides of stud framing.
- D. Non-Composite Partition Assemblies: Clad full height on only one side of stud framing; or clad partial height on either side of stud framing.
- E. Steel sheet thickness for metal framing specified in this Section is for uncoated conventional steel sheet. Where thickness is indicated by gage, comply with minimum thickness indicated in table below.

STEEL SHEET THICKNESSES				
DW = Drywall ST = Structural	Flat Steel Sheet			Gage Equivalent for Dimpled Steel Sheet
Gage	Uncoated Thickness	Minimum Thickness	Design Thickness	Uncoated Thickness
	Inch	Mils	Inch	Inch
25	0.018	18	0.0188	0.015
22	0.027	27	0.0283	-
20 DW	0.030	30	0.0312	0.025
20 ST	0.033	33	0.0346	0.028
18	0.043	43	0.0451	-
16	0.054	54	0.0566	-
14	0.068	68	0.0713	-
12	0.097	97	0.1017	-
10	0.118	118	0.1242	-

- F. Tie wire and hanger wire diameters (uncoated) and corresponding U.S. steel wire gage are indicated in the table below:

WIRE DIAMETER			
	Minimum Steel Base Metal (Uncoated) Diameter		Minimum Steel Base Metal (Uncoated) Diameter
Gage	Inch	Gage	Inch

20	0.0348	13	0.0915
19	0.0410	12	0.1055
18	0.0475	11	0.1205
17	0.0540	10	0.1350
16	0.0625	9	0.1483
14	0.0800	8	0.1620

- G. Dry Exposures: A location not normally subjected to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of kitchens or locker rooms.
- H. Damp Exposures: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of such locations include partially protected locations under canopies, marquees, roofed open balconies/porches, and like locations; and interior locations subject to moderate degrees of moisture, such as rooms with tubs and pools, rooms open to damp and wet exposures, crawl spaces, and like locations.
- I. Wet Exposures: Unprotected locations exposed to weather; locations subject to saturation with water or other liquids, such as showers, vehicle washing areas; installations underground or in concrete slabs or masonry in direct contact with the earth; installations in direct contact with water or other liquids, such as pools, fountains, and like locations.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include the following:
- Image or description of label or other identifying mark applied to steel studs and track visually indicating metal thickness or gage.
 - Embossed, High Strength Steel Studs and Tracks: Include framing manufacturer produced Limiting Wall Height table(s). Include letter signed by authorized representative of framing contractor certifying that steel thicknesses used in framing will comply with framing manufacturer's LWH tables for stud height or length, depth, lateral load, and deflection indicated for each partition type required Project.
- B. Design Variation(s) for Suspended Ceilings: Where indicated, Contractor may propose variations in sizing and spacing of suspension hangers, carrying channels, and furring channels from those specified. For each area and variation proposed, submittal shall include the following:
- Ceiling area for which variation is proposed.
 - All applicable tables from ASTM C754 annotated to indicate proposed variation(s).

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following from ICC-ES, an ANSI/CLASS ISO 17065 accredited agency, or other qualified agency acceptable to authorities having jurisdiction.
 - 1. Embossed, high strength steel studs and tracks.
 - 2. Firestop tracks.
 - 3. Power-actuated hanger fasteners.
 - 4. Screw type hanger fasteners.

1.6 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Framing members shall be certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Structural Performance: of Partition Assemblies Select stud base-steel thickness based on following criteria:
 - 1. Gypsum Board Clad Partitions:
 - a. Stud Depth and Spacing: As indicated on Drawings Partition Type Diagrams.
 - b. Horizontal Deflection: As indicated on Drawings Limiting Wall Height (LWH) Tables.
 - c. Horizontal Loading: 5 lbf/sq. ft.

2.2 FRAMING MEMBERS, GENERAL

- A. Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: See Part 1 Article for Definitions of Dry, Damp, and Wet Exposures.
 - a. Framed Assemblies at Dry Exposures: Hot dip galvanized per ASTM A653/A653M, G40 or coating with equivalent corrosion resistance of ASTM A653/A653M, G40, unless otherwise indicated.

- b. Framed Assemblies at Damp and Wet Exposures: Hot dip galvanized per ASTM A653/A653M, G60. Wet and damp exposures include, but are not limited to, the following:
 - 1) Shower rooms and rooms containing water spray devices.
 - 2) Toilet rooms and bathrooms with openings, including doorways, to shower rooms.
 - 3) Locker rooms with openings, including doorways, to shower rooms.

2.3 FRAMING SYSTEMS FOR PARTITIONS AND SOFFITS

- A. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
 - 1. Conventional Steel Studs and Tracks:
 - 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) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich Building Systems.
 - 3) Custom Stud.
 - 4) Jaimes Industries.
 - 5) MarinoWARE.
 - 6) MBA Building Supplies.
 - 7) MRI Steel Framing, LLC.
 - 8) Phillips Manufacturing Co.
 - 9) SCAFCO Steel Stud Company.
 - 10) Steel Construction Systems.
 - 11) Telling Industries.
 - 12) The Steel Network, Inc.
 - b. Minimum Base-Metal Thickness: As indicated on Drawing's Limiting Wall Height (LWH) Tables. Partition Type Drawings refer to LWH Table used for determining minimum base-steel thickness based on Limiting Wall Height of stud.
 - 1) Exception: Minimum 0.033 inch thickness required for framing supporting wall mounted casework.
 - c. Depth: As indicated on Drawings.
 - 2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.:
 - 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) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich Building Systems.
 - 3) MarinoWARE.
 - 4) MBA Building Supplies.
 - 5) Phillips Manufacturing Co.
 - 6) SCAFCO Steel Stud Company.
 - 7) Steel Construction Systems.
 - 8) Telling Industries.
 - 9) The Steel Network, Inc.
- b. Minimum Base-Metal Thickness: As required by structural performance requirements specified under Part 2 Article "Performance Requirements" and as selected from thicknesses available from manufacturer's published LWH Tables.
- c. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide system capable of allowing partition heads to expand and contract with movement of the structure to prevent axial loading on partition.
1. Minimum Vertical Movement: As indicated on Drawings.
 2. Provide one of the following:
 - a. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing for vertical movement indicated.
 - 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) CEMCO; California Expanded Metal Products Co.
 - b) ClarkDietrich Building Systems.
 - c) Fire Trak Corp.
 - d) MarinoWARE.
 - e) SCAFCO Steel Stud Company.
 - f) Steel Construction Systems.
 - g) Super Stud Building Products Inc.
 - h) The Steel Network, Inc.
 - b. Single Long-Leg Track System: ASTM C645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

- c. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction fit over inner track.
 - d. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 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) CEMCO; California Expanded Metal Products Co.
 - b) ClarkDietrich Building Systems.
 - c) MarinoWARE.
 - d) MBA Building Supplies.
 - e) Metal-Lite.
 - f) Perfect Wall, Inc.
 - g) SCAFCO Steel Stud Company.
 - h) Steel Construction Systems.
 - i) Telling Industries.
 - j) The Steel Network, Inc.
3. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of 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. Only products reported under ICC-ES will be accepted.
- 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) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich Building Systems.
 - 3) Fire Trak Corp.
 - 4) MarinoWARE.
 - 5) Metal-Lite.
 - 6) Perfect Wall, Inc.
 - 7) SCAFCO Steel Stud Company.
 - 8) Steel Construction Systems.
 - 9) The Steel Network, Inc.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness:
 - a. For Bracing: 0.018 inch unless indicated otherwise on Drawings.
 - b. For Blocking: 0.033 inch unless indicated otherwise on Drawings.
 2. 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. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFCO Steel Stud Company.
 - e. Steel Construction Systems.
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: 1-1/2 inches unless indicated otherwise on Drawings.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
 3. 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. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFCO Steel Stud Company.
 - e. Steel Construction Systems.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Metal Thickness: 0.018 inch unless indicated otherwise on Drawings.
 2. Depth: As indicated on Drawings.
 3. 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. ClarkDietrich Building Systems.
 - b. Jaimes Industries.
 - c. MarinoWARE.
 - d. MRI Steel Framing, LLC.
 - e. SCAFCO Steel Stud Company.
 - f. Steel Construction Systems.

- F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: As indicated on Drawings.
 - 2. 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. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFCO Steel Stud Company.
 - e. Steel Construction Systems.
- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch.
 - 1. Minimum Base-Metal Thickness: 0.018 inch unless indicated otherwise on Drawings.
 - 2. Depth: As indicated on Drawings.
 - 3. 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. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. MRI Steel Framing, LLC.
 - d. SCAFCO Steel Stud Company.
 - e. Steel Construction Systems.

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: For securing hangers to structure.
 - a. Type: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on following ICC-ES reports as appropriate for the substrate.
 - 1) Torque-controlled, expansion anchor; ICC-ES AC01 Expansion Anchors in Masonry Elements.
 - 2) Torque-controlled, expansion anchor; ICC-ES AC193 Mechanical Anchors in Concrete Elements.
 - 3) Torque-controlled, adhesive anchor; ICC-ES AC308 Post-Installed Adhesive Anchors Installed in Concrete Elements.

- 4) Adhesive anchor; ICC-ES AC58 Adhesive Anchors Installed in Masonry Elements.
- b. Material:
 - 1) For Interior Locations with Dry Exposure: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2) For Exterior and Interior Locations with Damp Exposures, and where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
 - 3) For Exterior and Interior Locations with Wet Exposures: Alloy Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
- c. Adhesive Anchor Limitations: Adhesive anchors shall not be used to resist tension loads in fire-resistive rated assemblies unless approved for such use in evaluation report or approved by authorities having jurisdiction.
- 2. Power-Actuated Anchors: For securing hangers to structure.
 - a. Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70 Power-actuated Fasteners Driven into Concrete, Steel and Masonry Elements.
 - b. Limit use to interior locations with Dry Exposure only.
- C. Screw Fasteners: For securing hangers to Metal Decking (Not Concrete Filled). Self-tapping screw designed for use with sheet metal decking; fastener includes self-drilling point and self-tapping threaded shank below a washer-like collar, and above the collar a smooth, straight shank transitioning to a flattened portion with an hole for attaching ceiling suspension wire; manufactured from steel with corrosion resistant coating.
 - 1. Only fasteners with a Evaluation Service Report from ICC-ES, Technical Evaluation Report from an ANSI/CLASS ISO 17065 accredited agency, or other agency approved by the AHJ will be accepted.
 - 2. Use of screw shall be limited to weight not exceeding that which ceiling system's hanger wire supports, as allowed by manufacturer's Service or Technical Evaluation Report with respect to base metal thickness and minimum tensile strength of metal roof decking.
 - 3. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to the following:
 - a. Doc's Marketing Corp.; I-LAG Brand Eye Lag Screws, 175 SD or 750 SD (ICC ESR-3135).
 - b. Or Equal.
- D. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, in following size:
 - 1. Not less than 0.1055 inch diameter. Provide greater diameter as required for conditions indicated per ASTM C754, Table 6. See Part 3 Article "Installing Ceiling Suspension Systems" for Design Variation options.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches, unless indicated otherwise on Drawings. Do not exceed allowable spans indicated under Table 7 of ASTM C754. See Part 3 Article "Installing Ceiling Suspension Systems" for Design Variation options.
- F. Furring Channels (Furring Members):
1. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.018 inch unless indicated otherwise on Drawings.
 - b. Depth: As follows unless indicated otherwise on Drawings:
 - 1) For Spans Not Exceeding 5 ft.: 1-5/8 inches.
 - 2) For Spans Not Exceeding 6 ft.: 2-1/2 inches.
 - 3) For Spans Not Exceeding 8 ft.: 3-5/8 inches.
 2. Embossed, High Strength Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.015 inch unless indicated otherwise on Drawings.
 - b. Depth: As follows unless indicated otherwise on Drawings:
 - 1) For Spans Not Exceeding 5 ft.: 1-5/8 inches.
 - 2) For Spans Not Exceeding 6 ft.: 2-1/2 inches.
 - 3) For Spans Not Exceeding 8 ft.: 3-5/8 inches.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.018 inch unless indicated otherwise on Drawings.
 - b. For spans not exceeding 4 ft..
 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical unless hat shaped indicated on Drawings.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
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. Armstrong World Industries, Inc.
 - b. Rockfon (Rockwool International).
 - c. USG Corporation.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Installation Standard: ASTM C754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. For partitions, comply with spacings indicated on Partition Types Drawings.
 2. For framed assemblies other than partitions, but including soffits, comply with ASTM C754, Table 1 except as follows:
 - a. Tile Backing Panels: 16 inches o.c. maximum.
- C. Where studs are installed directly against exterior masonry or concrete walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- D. Install studs so flanges within framing system point in same direction.

- E. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- F. Direct Furring:
 - 1. Screw to steel framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- G. Z-Shaped Furring Members:
 - 1. Space furring members as indicated on Drawings.
 - 2. Where insulation is shown nested in framing members, install full (uncut) width units vertically and hold in place with Z-furring members; at inside corners cut insulation to fit. Insulation is specified in Section 07 21 00 "Thermal Insulation."
 - 3. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 4. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner.
- H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

- B. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches o.c. unless indicated otherwise on Drawings. Contractor may submit Design Variation, at their discretion, allowed by ASTM C754, Tables 6 & 7 for each area and condition indicated.
 - 2. Carrying Channels, Main Runners, and Main Grid Beams: 48 inches o.c. unless indicated otherwise on Drawings. Contractor may submit Design Variation, at their discretion, allowed by ASTM C754, Tables 6 & 7 for each area and condition indicated.
 - 3. Furring Channels (Furring Members): 16 inches o.c. unless indicated otherwise on Drawings. Contractor may submit Design Variation, at their discretion, allowed by ASTM C754, Tables 1 & 2 for each area and condition indicated.
- C. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- D. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Do not attach hangers to steel roof deck except with approval of Architect.
 - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- E. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- F. Seismic Bracing: Sway-brace suspension systems with hangers used for support unless indicated otherwise on Drawings.
- G. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- H. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile and resinous glazed coating backing panels.
- B. Components used with fire-resistance-rated head of wall systems are specified under Section 07 84 43 "Joint Firestopping." Metal top runner for metal wall framing are selected under Section 09 22 16 "Non-Structural Metal Framing."
- C. Related Requirements:
 - 1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 DEFINITIONS

- A. Partition type are indicated on Drawings as:
 - 1. Types A### for Acoustic rated partitions.
 - 2. Types R### for Fire-Resistive-Rated partitions.
 - 3. Types S### for Standard partitions (neither fire-resistive- or acoustic rates).
 - 4. Types F### for Furred partitions.
 - 5. Types HZ## for Horizontal Membrane Assemblies
- B. Wet and Humid Spaces: Includes, but is not limited to, the following:
 - 1. Toilet rooms
 - 2. Bath rooms.
 - 3. Shower rooms.
 - 4. Locker rooms abutting shower rooms and bathrooms.

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

ICTC Calxico Intermodal Transit Center

IFB Deliverable

GYPSUM BOARD

09 29 00 - 1

02/01/24

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- 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. American Gypsum.
 - 2. CertainTeed Corporation.
 - 3. Georgia-Pacific Building Products.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. PABCO Gypsum.
 - 7. Temple-Inland Building Product by Georgia-Pacific.
 - 8. USG Corporation.
- B. Gypsum Wallboard, Regular Type: ASTM C 1396/C 1396M.
 - 1. Thickness: As indicated on Drawing's Partition Type sheets.
 - 2. Long Edges: Tapered.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: As indicated on Drawing's Partition Type sheets.
 2. Long Edges: Tapered.
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: As indicated on Drawing's Partition Type sheets.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 4. Application: Painted walls and partitions in wet and humid spaces. Including toilet rooms, bathrooms, lockers room and custodial closets.
- E. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
1. Thickness: As required by fire-resistance-rated assembly indicated on Drawing's Partition Type sheets.
 2. Long Edges: Tapered.

2.4 TILE AND RESINOUS GLAZED COATING BACKING PANELS

- A. Coated Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Core: As indicated on Drawing's Partition Type sheets.
 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 3. Application: For walls receiving ceramic tile in shower compartments.
- B. Cementitious Backer Units, 5/8 inch: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
1. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Moisture- and Mold-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: As indicated on Drawing's Partition Type sheets.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 4. Application: For walls receiving tile in spaces other than shower compartments.

2.5 TRIM ACCESSORIES

- A. Interior Trim for Dry Spaces: ASTM C 1047.
1. Material: Any of the following:
 - a. Galvanized or aluminum-coated steel sheet.
 - b. Rolled zinc.

ICTC Calxico Intermodal Transit Center

IFB Deliverable

GYPSUM BOARD
09 29 00 - 3
02/01/24

- c. Paper-faced galvanized steel sheet
- 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
- B. Interior Trim for Backing Panels and Wet or Humid Spaces: ASTM C 1047.
 - 1. Material: Any of the following:
 - a. Galvanized or aluminum-coated steel sheet.
 - b. Rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use the following:
 - a. Dry Spaces: Drying-type, all-purpose compound, except:
 - 1) Use setting-type taping compound for installing paper-faced metal trim accessories.
 - 2) Setting-type taping compound may be used at Contractor's discretion.
 - b. Wet or Humid Spaces: Setting-type taping compound.
 - 3. Fill Coat: For second coat, use the following:
 - a. Dry Spaces: Drying-type, all-purpose compound, except setting-type, sandable topping may be used at Contractor's discretion.

- b. Wet or Humid Spaces: Setting-type sandable topping compound.
- 4. Finish Coat: For third coat, use the following:
 - a. Dry Spaces: Drying-type, all-purpose compound, except setting-type, sandable topping may be used at Contractor's discretion.
 - b. Wet or Humid Spaces: Setting-type sandable topping compound.
- 5. Skim Coat: For final coat of Level 5 finish, use the following:
 - a. Dry Spaces: Either of following:
 - 1) Drying-type, all-purpose compound, except setting-type, sandable topping compound may be used at Contractor's discretion.
 - 2) High-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
 - b. Wet or Humid Spaces: Setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Coated Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.
 - 3. Moisture- and Mold-Resistant Gypsum Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws comply with ASTM C 1002 for fastening panels to steel members less than 0.033 inch thick (20 ga. ST).
 - 2. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 3. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

- E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Sealant shall have a VOC content of 250 g/L or less.
- F. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. 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.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8 inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2 inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

ICTC Callexico Intermodal Transit Center

GYPSUM BOARD

09 29 00 - 6

IFB Deliverable

02/01/24

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. 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 panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. 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.
3. On 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.
4. Fastening Methods:
 - a. For acoustic rated partitions Types A### comply with acoustic performance test references indicated on Drawing's Partition Types sheet.

ICTC Calxico Intermodal Transit Center

GYPSUM BOARD

IFB Deliverable

09 29 00 - 7

02/01/24

- b. For fire-resistive-rated partitions Types R### comply with fire-resistance test references indicated on Drawing's Partition Types sheet.
 - c. For standard partition Types S### and furred partition Types F### fasten base layers and face layers separately to supports with screws or fasten base layers with screws and fasten face layers with adhesive and supplementary fasteners.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

- A. Coated Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers in ADOPs building and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at showers in FWF and where indicated.
- C. Moisture- and Mold-Resistant Backing Board: Install at other walls (not showers) receiving tile with 1/4-inch gap where panels abut other construction or penetrations.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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 according to ASTM C 840 (System XIII: Control (Expansion) Joints) and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. LC-Bead: Use at panel edges where edge is exposed to view.
 - 3. L-Bead: Use at panel edges stopping short of another material or abutting another material, where edge is not exposed to view, and where panel face is exposed to view.
 - 4. U-Bead: Use at panel edges receiving sealant, and where face of panel is not exposed to view.

3.6 FINISHING GYPSUM BOARD

- 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 and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: At following locations:
 - a. Panels that are substrate for ceramic and stone tile.
 - 3. Level 3: At following locations:
 - a. Panels that are substrate receiving heavily textured wallcoverings.
 - 4. Level 4:
 - a. At following locations:
 - 1) At panel surfaces that will be exposed to view unless otherwise indicated.
 - 2) Where indicated on Drawings.
 - b. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 - 5. Level 5:
 - a. At following locations:
 - 1) At panel surfaces receiving smooth, gloss sheen paints and coatings.
 - 2) Where indicated on Drawings.
 - b. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 30 13
CERAMIC TILING

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 the following for interior applications:
 - 1. Ceramic tile.
 - 2. Tile backing panels.
 - 3. Waterproof membrane for thinset applications.
 - 4. Crack isolation membrane.
 - 5. Metal edge strips.
- B. See end of Section for TILE INSTALLATION SCHEDULE(S).
- C. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Metal edge strips in 6-inch lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of product.
- B. Product Test Reports: For the following:
 1. Tile-setting products.
 2. Tile-grouting products.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of wall tile installation.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations:
 - 1. Tile: Obtain tile of each type and color or finish from:
 - a. Single source or producer.
 - b. Same production run and of consistent quality in appearance and physical properties for each contiguous area.
 - 2. Obtain the following from the same manufacturer as setting materials when used in contact with each other:
 - a. Waterproof membrane of following type(s):
 - 1) Fabric-reinforced, fluid-applied membrane.
 - 2) Fluid-applied membrane.
 - b. Crack isolation membrane of following type(s):
 - 1) Fabric-reinforced, fluid-applied membrane.
 - 2) Fluid-applied membrane.
 - c. Setting materials of the following type(s):
 - 1) Standard dry-set mortar (thinset) or dry-set portland cement mortar (thinset).
 - 2) Modified dry-set mortar (thinset) or latex-portland cement mortar (thinset).
 - 3) Medium-bed, modified dry-set mortar or medium-bed, latex-portland cement mortar.
 - d. Grout materials of the following type(s):
 - 1) High-performance tile grout.
 - 3. Obtain each of the following products specified in this Section from a single manufacturer:
 - a. Corrugated polyethylene crack isolation membrane.
 - b. Tile backing panels.
 - c. Metal edge strips.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Ceramic Tile:
 - 1. Basis-of-Design Product(s): Subject to compliance with requirements, provide Product(s) indicated on Drawings Finish Schedule (no known equals).
 - a. Comparable products shall be submitted as a substitution request in accordance with Section 01 25 00 "Substitution Procedures."
 - 2. Trim Units: As follows unless indicated otherwise on Drawings and Finish Schedule. Coordinate trim units with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes or fabricated from flat tile:
 - a. Base Cap for Thinset Mortar Installations: Surface bullnose or beveled.
 - b. Wainscot Cap for Thinset Mortar Installations: Surface bullnose or beveled.
 - c. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
 - d. External Corners for Thinset Mortar Installations: Surface bullnose or beveled.
 - e. Internal Corners: Field-buttet square corners.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
 - 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. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; ProTEC Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch, unless indicated otherwise on Drawings.
- B. Fiber-Cement Backer Board: ASTM C 1288, in maximum lengths available to minimize end-to-end butt joints.
- 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. CertainTeed Corporation; FiberCement BackerBoard.
 - b. James Hardie Building Products, Inc.; Hardiebacker 500.
 - 2. Thickness: As indicated on Drawings.
- C. Moisture- and Mold-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
- 1. Thickness: As indicated on Drawings.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - 4. Application Restrictions: Do not use at locations including the following:
 - a. Surfaces receiving water spray, showers, bathtub surrounds.
 - b. Steam rooms, saunas.
 - c. Natatoriums, indoor pool rooms.

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 - 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. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane with B 6000 Mesh.
 - b. Bostik, Inc.; Hydroment Blacktop 90210.
 - c. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
 - d. MAPEI Corporation; Mapelastic HPG with MAPEI Fiberglass Mesh.
 - e. Merkrete Systems, Parex USA, Inc.; Hydro-Guard 2000.
- C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Basis of Design Product: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; RedGard Waterproofing and Crack Prevention Membrane.
 - b. Or equal by one of the following:
 - 1) Laticrete International, Inc.
 - 2) MAPEI Corporation.

2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
 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. Schluter Systems L.P.; DITRA.
- C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
 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. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane with B 6000 Mesh.
 - b. Bostik, Inc.; Hydroment Blacktop 90210.
 - c. Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane.
 - d. MAPEI Corporation; Mapelastic HPG with MAPEI Fiberglass Mesh.
 - e. Merkrete Systems, Parex USA, Inc.; Hydro-Guard 2000.
- D. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 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. Bostik, Inc.; Durabond D-222 Duraguard Membrane.
 - b. C-Cure; Pro-Red Waterproofing Membrane 963.
 - c. Laticrete International, Inc.; Laticrete Hydro Ban.
 - d. MAPEI Corporation; Mapelastic AquaDefense.
 - e. Merkrete Systems, Parex USA, Inc.; Fracture Guard 5000.

2.7 SETTING MATERIALS

- A. Standard Dry-Set Mortar (Thinset) or Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.

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. Boiardi Products Corporation; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; H. B. Fuller Construction Products Inc.
 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- B. Modified Dry-Set Mortar (Thinset) or Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
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. Ardex Americas.
 - b. Boiardi Products Corporation; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Merkrete Systems; Parex USA, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; H. B. Fuller Construction Products Inc.
 2. Provide either of following:
 - a. Prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

- b. Prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - 3. Application: For use with ceramic tile complying with all of the following restrictions:
 - a. Tiles with no edge longer than 15 inches.
 - b. Tiles weighing no more than 5 lbs/sq ft.
 - c. Not for use with tiles having ungauged thickness.
 - 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- C. Dry Set Mortar for Large and Heavy Tile (LHT Mortar) (formerly Medium-Bed, Modified Dry-Set Mortar or Medium-Bed, Latex-Portland Cement Mortar): Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness indicated.
 - 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. Ardex Americas.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Merkrete Systems; Parex USA, Inc.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; H. B. Fuller Construction Products Inc.
 - 2. Provide either of following:
 - a. Prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - b. Prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - 3. Application: For use with ceramic floor tile 15 inches long one edge or larger, tiles weighing 5 lbs/sq ft or heavier, and tiles with ungauged thickness.
 - 4. For transparent or translucent glass tile use white mortar.

2.8 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7.

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. Ardex Americas.
 - b. Boiardi Products Corporation; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; H. B. Fuller Construction Products Inc.
2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
3. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge and Transition Strips: Angle or L-shaped, height to match tile and setting-bed thickness, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on Drawings and as required, or comparable product by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/8 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Metal Edge Strips: Install at locations indicated.
- K. Grout Sealer: Apply grout sealer to cementitious grout joints at all according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

- A. Install panels and treat joints according manufacturer's written instructions for type of application indicated.
 - 1. For cementitious backer units comply with ANSI A108.
 - 2. For fiber-cement backer board comply with ASNI A108.
 - 3. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.7 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.9 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W248; tile on mortar bond coat on glass-mat, water-resistant gypsum backer board substrate.
 - a. Ceramic Tile Type:
 - 1) As indicated on Drawings.
 - b. Bond Coat Mortar:
 - 1) Standard dry-set mortar (thinset) or dry-set portland cement mortar (thinset).
 - 2) Modified dry-set mortar (thinset) or latex-portland cement mortar (thinset).

- 3) Medium-bed, modified dry-set mortar or medium-bed, latex-portland cement mortar.
 - 4) Improved modified dry-set mortar (thinset).
 - c. Grout:
 - 1) Sand-portland cement grout; for joints 1/8 inch wide or greater.
 - 2) Standard cement grout as follows:
 - a) Un-sanded grout for joints 1/8 inch wide or less.
 - b) Sanded grout for joints 1/8 inch wide or greater.
 - 3) High-performance tile grout as follows:
 - a) Un-sanded grout for joints 1/8 inch wide or less.
 - b) Sanded grout for joints 1/8 inch wide or greater.
 - 4) Water-cleanable epoxy grout.
 - 5) Grout for pregrouted tile sheets.
 - d. Application: At all wall locations except showers.
- B. Wall and Built-up Shower Receptor Installations:
1. Ceramic Tile Installation: TCNA B420; wall tile on mortar bond coat on waterproof membrane on coated glass-mat, water-resistant gypsum backer board substrate; floor tile on bond coat mortar on cement mortar bed reinforced with wire fabric on waterproof membrane on sloped fill on floor slab/deck.
 - a. Ceramic Tile Type:
 - 1) As indicated on Drawings.
 - b. Bond Coat Mortar:
 - 1) Standard dry-set mortar (thinset) or dry-set portland cement mortar (thinset).
 - 2) Modified dry-set mortar (thinset) or latex-portland cement mortar (thinset).
 - 3) Medium-bed, modified dry-set mortar or medium-bed, latex-portland cement mortar.
 - 4) Improved modified dry-set mortar (thinset).
 - c. Wall Waterproof Membrane:
 - 1) Fluid-applied membrane with 2 inch alkali-resistant glass fiber mesh tape.
 - 2) Apply at following locations; tape joints:
 - a) Seams, corners, fasteners, and other penetrations in backer board, and to protect adjacent building materials.
 - b) Base flashing and other termination points.
 - c) Waterproofing need not be applied to undamaged field of coated glass-mat facing.

- d. Shower Receptor Cement Mortar Bed Reinforced with Wire Fabric: Portland cement mortar with or without latex additive at Contractors option.
- e. Shower Receptor Waterproof Membrane: One of following:
 - 1) Chlorinated polyethylene sheet.
 - 2) PVC sheet.
 - 3) Polyethylene sheet.
 - 4) Fabric-reinforced, modified-bituminous sheet.
 - 5) Fabric-reinforced, fluid-applied membrane.
 - 6) Fluid-applied membrane.
 - 7) Latex-portland cement waterproof mortar.
 - 8) Waterproofing and tile-setting adhesive.
- f. Grout:
 - 1) Sand-portland cement grout; for joints 1/8 inch wide or greater.
 - 2) Standard cement grout as follows:
 - a) Un-sanded grout for joints 1/8 inch wide or less.
 - b) Sanded grout for joints 1/8 inch wide or greater.
 - 3) High-performance tile grout as follows:
 - a) Un-sanded grout for joints 1/8 inch wide or less.
 - b) Sanded grout for joints 1/8 inch wide or greater.
 - 4) Water-cleanable epoxy grout.
 - 5) Grout for pregrouted tile sheets.
- g. Application: At shower walls and minimum of 24-inches beyond shower curtains.

END OF SECTION

SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch- square samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.
 - 3. Clips: Full-size hold-down clips.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- C. Sample Warranty: For special warranty.
- D. USG ClimaPlus 30 year limited system warranty: Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.

1.6 CLOSEOUT SUBMITTALS

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

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. USG ClimaPlus limited system warranty: Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.
 2. Warranty Period: Thirty years limited system warranty beginning from date of Substantial Completion.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Class A according to ASTM E 1264.
 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Armstrong Ultima** or comparable product by one of the following:
 - 1. American Gypsum.
 - 2. Armstrong World Industries, Inc.
 - 3. CertainTeed Corporation.
 - 4. Chicago Metallic Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Recycled Content: 80 percent.
- D. Classification: ASTM E1264.
 - 1. Type and Form: Type IV, Form 2.
 - 2. Pattern: E.
- E. Color: White.
- F. Light Reflectance (LR): Not less than 0.88.
- G. Ceiling Attenuation Class (CAC): Not less than 35.
- H. Edge/Joint Detail: 9/16-inch tegular.
- I. Thickness: 1 inch.
- J. Modular Size: 2 feet by 2 feet.
- K. Panel Features: Washable, scrubable, soil and impact resistant finish.

2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **USG DXL** or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Chicago Metallic Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- C. Wide-Face, Aluminum-Capped, Double-Web, Fire-Rated, Hot-Dip Galvanized, G60 , Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized, G60 coating designation; with prefinished, 15/16-inch- wide aluminum caps on flanges.
 - 1. Structural Classification: Heavy-duty system.
 - 2. Face Design: Flat, flush.
 - 3. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- C. Hold-Down Clips: Manufacturer's standard hold-down.
- D. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.6 METAL EDGE MOLDINGS AND TRIM Insert drawing designation

- A. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils . Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 6. Do not attach hangers to steel deck tabs.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Thermoplastic-rubber base.
 - 3. Rubber molding accessories.
- B. Base Product Option: Provide either thermoset-rubber or thermoplastic-rubber base at Contractor's discretion.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 2. Flexco.
 - 3. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style B, Cove.
- C. Thickness: 0.125 inch.
- D. Height: As indicated on Drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated by manufacturer's designations.

2.2 THERMOPLASTIC-RUBBER BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Interior Finish & Material Legend Drawing or comparable product by one of the following:
 - 1. AB; American Biltrite.
 - 2. Allstate Rubber Corp.
 - 3. Armstrong World Industries, Inc.
 - 4. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 5. Flexco.
 - 6. Johnsonite; A Tarkett Company.
 - 7. Mondo Rubber International, Inc.
 - 8. Nora Systems, Inc.
 - 9. Roppe Corporation, USA.
 - 10. VPI, LLC, Floor Products Division.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous) or II (layered).
 - 2. Style and Location:

- a. Style B, Cove.
- C. Thickness: 0.125 inch.
- D. Height: As indicated on Drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated by manufacturer's designations.

2.3 RUBBER MOLDING ACCESSORY

- A. Basis of Design Products: Subject to compliance with requirements, provide the following:
 - 1. Roppe Corporation, USA.
 - 2. Or comparable products by, but not limited to, the following:
 - a. VPI, LLC, Floor Products Division.
- B. Description:
 - 1. Carpet and Tile or Sheet Flooring Joiner: For transitions between carpet and ceramic tile, resilient tile and resilient sheet provide one or more of the following products as required to fit transition profile and dimension conditions:
 - a. Roppe; #50 Tile/Carpet Joiner 7/32".
 - b. Roppe; #60 Tile/Carpet Joiner 3/8".
 - c. Roppe; #56 Tile/Carpet Joiner 1/2".
 - 2. Carpet Edge for Glue-Down Applications. For transitions between carpet unfinished slab or deck provide one or more of the following products as required to fit transition profile and dimension conditions:
 - a. Roppe; #42 Custom Carpet Edging 3/16" Undercut.
 - b. Roppe #43 Custom Carpet Edging 1/4" Undercut.
 - c. Roppe; #38 Glue-Down Carpet Edge 1/4".
 - d. Roppe #40 Carpet Edge Guard 9/32".
 - e. Roppe; #39 Glue-Down Carpet Edge 5/16".
 - 3. Reducer Strip for Resilient Floor Covering. For transitions between resilient flooring (tile and sheet) and unfinished slab or deck provide one or more of the following products as required to fit transition profile and dimension conditions:
 - a. Roppe; #21 Reducer Strip 0.080".
 - b. Roppe; #22 Reducer Strip 1/8".
 - c. Roppe; #48 Reducer Strip 3/32".
 - d. Roppe; #23 Reducer Strip 3/16".
 - e. Roppe; #25 Reducer Strip 5/16".
 - f. Roppe; #26 Reducer Strip 3/8".

- g. Roppe; #20 Transitional Reducer 7/16".
- h. Roppe; #49 Transitional Reducer 9/16".
- C. Locations: Provide rubber molding accessories in areas indicated.
- D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT MOLDING ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 91 13
EXTERIOR 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. Section includes surface preparation and the application of paint systems on the following exterior substrates.
 - 1. Steel and iron.
 - 2. Galvanized metal.
 - 3. Aluminum (not anodized or otherwise coated).
- B. See EXTERIOR PAINTING SCHEDULE at end of Section.
- C. Related Requirements:
 - 1. Section 05 12 00 "Structural Steel Framing" for shop priming of metal substrates.
 - 2. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.
 - 3. Section 05 52 13 "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.

- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

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. Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. Diamond Vogel Paints.
 4. Dunn-Edwards Corporation.
 5. Frazee Paint; Comex Group.
 6. Glidden Professional.
 7. Kelly-Moore Paint Company Inc.
 8. PPG Architectural Finishes, Inc.
 9. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 10. Sherwin-Williams Company (The).
- B. Products (As Scheduled): Subject to compliance with requirements provide products listed in the Exterior Painting Schedule at end of this Section. Products are listed (with some exceptions) by MPI number and shall be selected from the "MPI Approved Products Lists" (see www.paintinfo.com/mpi/approved/Manufactory_index.shtml). Equivalent products not included in the "MPI Approved Products Lists" shall be submitted as substitution requests.

2.2 PAINT, GENERAL

- A. MPI Standards: Unless indicated otherwise, products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists," except if approved by a substitution request.
- B. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content, General: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction.
- D. Colors: As indicated on Drawings Paint Schedule.
1. Ten percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Bare Steel Substrates: Remove rust, loose mill scale, and residual coatings if any. Clean using methods recommended in writing by paint manufacturer but not less than SSPC-SP 7/NACE No. 4, Brush-Off Blast Cleaning or SSPC-SP 11, Power Tool Cleaning to Bare Metal.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 (Shop, Field, and Maintenance Painting of Steel) for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Paint entire exposed surface of window frames and sashes.
 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Steel and Iron Substrates.
 1. Water-Based Light Industrial Coating System MPI EXT 5.1B/C/M/N/R:

- a. Prime Coat: One of following:
 - 1) Primer, zinc rich, inorganic, MPI #19 for 5.1B.
 - 2) Primer, alkyd, anti-corrosive for metal, MPI #79 for 5.1C.
 - 3) Primer, epoxy, water based, anti-corrosive, for metal, MPI #301 for 5.1M.
 - 4) Primer, epoxy, anti-corrosive MPI #101 for 5.1N & 5.1R.
 - 5) Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat:
 - 1) For 5/1B: Light industrial coating, exterior, water based, matching topcoat. Apply where Premium Grade system is indicated.
 - 2) For 5.1C/M/N: Light industrial coating, exterior, water based, matching topcoat. Application required.
 - 3) For 5.1R: Epoxy, high build, low gloss MPI #108. Application required.
- c. Topcoat: One of following matching gloss level indicated.
 - 1) Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
 - 2) Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
 - 3) Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

B. Galvanized-Metal Substrates.

- 1. Water-Based Light Industrial Coating System MPI EXT 5.3G/J/K:
 - a. Prime Coat: One of following:
 - 1) Primer, galvanized, cementitious, MPI #26 for 5.3G.
 - 2) Primer, galvanized, water based, MPI #134 for 5.3J.
 - 3) Primer, epoxy, anti-corrosive, MPI #101 for 5.3K.
 - 4) Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat. Apply where Premium Grade system is indicated.
 - c. Topcoat: One of following matching gloss level indicated.
 - 1) Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
 - 2) Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
 - 3) Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

C. Aluminum Substrates (Not Anodized or Otherwise Coated).

1. Water-Based Light Industrial Coating System MPI EXT 5.4G:
 - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat. Apply where Premium Grade system is indicated.
 - c. Topcoat: One of following matching gloss level indicated.
 - 1) Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
 - 2) Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
 - 3) Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

END OF SECTION

SECTION 09 91 23
INTERIOR 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. Section includes surface preparation and the application of paint systems on the following interior substrates.

- 1. Concrete.
 - a. Non-traffic bearing surfaces.
- 2. Concrete masonry units (CMUs).
- 3. Steel and iron.
- 4. Galvanized metal.
- 5. Aluminum (not anodized or otherwise coated).
- 6. Gypsum board.

- B. See INTERIOR PAINTING SCHEDULE at end of Section.

- C. Related Requirements:

- 1. Section 05 12 00 "Structural Steel Framing" for shop priming structural steel.
- 2. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.
- 3. Section 05 52 13 "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.3 DEFINITIONS

- A. MPI Gloss Level 1 (Flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2 (Velvet-Like): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3 (Eggshell-Like): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to D 523.
- D. MPI Gloss Level 4 (Satin-Like): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7 (High Gloss): More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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. Behr Process Corporation.
 - 2. Benjamin Moore & Co.
 - 3. Diamond Vogel Paints.
 - 4. Dunn-Edwards Corporation.
 - 5. Frazee Paint; Comex Group.
 - 6. Glidden Professional.
 - 7. Kelly-Moore Paint Company Inc.
 - 8. Kwal Paint; Comex Group.
 - 9. PPG Paints.
 - 10. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 - 11. Sherwin-Williams Company (The).
 - 12. Valspar Corporation.
 - 13. Vista Paint Corporation.
- B. Products (As Scheduled): Subject to compliance with requirements provide products listed in the Interior Painting Schedule at end of this Section. Products are listed (with some exceptions) by MPI number and shall be selected from the "MPI Approved Products Lists" (see www.paintinfo.com/mpi/approved/Manufactory_index.shtml). Equivalent products not included in the "MPI Approved Products Lists" shall be submitted as substitution requests.

2.2 PAINT, GENERAL

- A. MPI Standards: Unless indicated otherwise, products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists," except if approved by a substitution request.
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

- C. ASHRAE - Emissions Requirements: Field-applied paints and coatings that are inside the weatherproofing system shall comply with either of the following:
 - 1. ASHRAE - VOC content shall not exceed limits of authorities having jurisdiction and the following and as indicated on Drawings:
- D. Colors: As indicated on Drawings Paint Schedule.
 - 1. Five percent of surface area will be painted with deep tones as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Concrete Masonry Units (CMUs): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

- E. Concrete Masonry Unit (CMU) Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Bare Steel Substrates: Remove rust, loose mill scale, and residual coatings, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. Substrates Not Subject to Wetting by Condensation, Dampness, or Humidity: SSPC-SP 2, Hand Tool Cleaning or SSPC-SP 3, Power Tool Cleaning as required to achieve a clean surface.
 - 2. Substrates Subject to Wetting by Condensation, Dampness, or Humidity: SSPC-SP 7/NACE No. 4, Brush-Off Blast Cleaning or SSPC-SP 11, Power Tool Cleaning to Bare Metal.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 (Shop, Field, and Maintenance Painting of Steel) for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Occupied Spaces: Paint the following work where exposed:
 - a. Equipment, including panelboards.

- b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Owner.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces.
 - 1. High-Performance Architectural Latex System MPI INT 3.1C:
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat. Apply where Premium Grade system is indicated.
 - c. Topcoat: One of following matching gloss level indicated.
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 4) Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
- B. CMU Substrates.
 - 1. High-Performance Architectural Latex System MPI INT 4.2D/P:
 - a. Primer/Block Filler: One of following:

- 1) Block filler, latex, interior/exterior, MPI #4 for 4.2D.
- 2) Primer, alkali resistant, water based, MPI #3 for 4.2P.
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat. Apply where Premium Grade system is indicated.
- c. Topcoat: One of following matching gloss level indicated.
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 4) Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

C. Steel Substrates.

1. High-Performance Architectural Latex System MPI INT 5.1R/RR:

- a. Prime Coat: One of following:
 - 1) Alkyd, quick dry, for metal, MPI #76 for 5.1R.
 - 2) Alkyd, anti-corrosive, for metal, MPI #79 for 5.1RR.
 - 3) Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat. Apply where Premium Grade system is indicated.
- c. Topcoat: One of following matching gloss level indicated:
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 4) Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

2. Water-Based Dry-Fall System MPI INT 5.1C/CC/Z:

- a. Prime Coat: One of following:
 - 1) Alkyd, quick dry, for metal, MPI #76 for 5.1C.
 - 2) Alkyd, anti-corrosive, for metal, MPI #79 for 5.1CC.
 - 3) Quick dry, for shop application, MPI #275 for 5.1Z.
 - 4) Shop primer specified in Section where substrate is specified.
- b. Topcoat: One of following matching gloss level indicated:
 - 1) Dry fall, latex, flat, MPI #118.

- 2) Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.
- 3) Dry fall, latex (MPI Gloss Level 3), MPI #155.
- 4) Dry fall, water based, for galvanized steel, (MPI Gloss Level 3), MPI #131.
- 5) Dry fall, latex (MPI Gloss Level 5), MPI #226.
- 6) Dry fall, water based, for galvanized steel, (MPI Gloss Level 5), MPI #158.

D. Galvanized-Metal Substrates.

1. High-Performance Architectural Latex System MPI INT 5.3M:

- a. Prime Coat: One of following:
 - 1) Primer, galvanized, water based, MPI #134.
 - 2) Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat. Apply where Premium Grade system is indicated.
- c. Topcoat: One of following matching gloss level indicated:
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 4) Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

2. Water-Based Dry-Fall System MPI INT 5.3H:

- a. Prime Coat: One of following:
 - 1) Dry fall, water based, for galvanized steel, matching topcoat.
 - 2) Shop primer specified in Section where substrate is specified.
- b. Topcoat: One of following matching gloss level indicated:
 - 1) Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.
 - 2) Dry fall, water based, for galvanized steel, (MPI Gloss Level 3), MPI #131.
 - 3) Dry fall, water based, for galvanized steel, semi-gloss (MPI Gloss Level 5), MPI #158.

E. Aluminum Substrates (Not Anodized or Otherwise Coated).

1. High-Performance Architectural Latex System MPI INT 5.4F:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat. Apply where Premium Grade system is indicated.
- c. Topcoat: One of following matching gloss level indicated:
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 4) Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

F. Gypsum Board Substrates.

- 1. High-Performance Architectural Latex System MPI INT 9.2B:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat. Apply where Premium Grade system is indicated.
 - c. Topcoat: One of following matching gloss level indicated:
 - 1) Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 2) Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 3) Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 4) Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

END OF SECTION

SECTION 09 96 23
GRAFFITI-RESISTANT COATINGS

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 sacrificial clear graffiti-resistant coatings for the following vertical surface materials:
 - 1. Concrete masonry units.
- B. Application:
 - 1. Outside perimeter CMU walls of building, from finished grade to 10 foot above finished grade.
- C. Related Sections:
 - 1. Section 04 20 00 "Unit Masonry" for concrete masonry units.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for graffiti-resistant coating for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.
- B. Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.
- C. Certification by graffiti-resistant coating manufacturer that products supplied comply with local regulations controlling use of VOCs.
- D. Material Test Reports: Indicate and interpret test results for compliance of graffiti-resistant coating with requirements indicated.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who employs only persons trained and approved by graffiti-resistant coating manufacturer for application of manufacturer's products.
- B. Regulatory Requirements: Comply with applicable rules of pollution-control regulatory agency having jurisdiction in Project locale regarding VOCs and use of hydrocarbon solvents.
- C. Field Samples: Architect will select one representative surface for each substrate to receive graffiti-resistant coating. Apply graffiti-resistant coating to each substrate, with either partial or full coverage as directed by Owner. Comply with application requirements of this Section.

1. Obtain Architect's approval of field samples before applying graffiti-resistant coating.
2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

1.5 PROJECT CONDITIONS

- A. Weather and Substrate Conditions: Do not proceed with application of graffiti-resistant coating under any of the following conditions, except with written instruction of manufacturer:
 1. Ambient temperature is less than 40 deg F.
 2. Ambient temperature not more than 90 deg F.
 3. Concrete masonry surfaces and mortar have cured for less than 28 days.
 4. Rain or temperatures below 40 deg F are predicted within 24 hours.
 5. Application is earlier than 24 hours after surfaces have been wet.
 6. Substrate is frozen or surface temperature is less than 40 deg F.
 7. Windy condition exists that may cause graffiti-resistant coating to be blown onto vegetation or surfaces not intended to be coated.
- B. Protect freshly coated surfaces from rain for two hours following application.

PART 2 - PRODUCTS

2.1 GRAFFITI COATING SYSTEM

- A. General: Provide products with no VOC's.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 1. ProSoCo, Inc.
 - a. For Porous and Textured Surfaces: Defacer Eraser SC-1, water-thin liquid for spray application.
 2. Textured Coatings of America, Inc.; Sacrificial Graffiti Guard System.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate of substances that might interfere with penetration or performance of graffiti-resistant coating. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.
- B. Test each type of surface according to graffiti-resistant coating manufacturer's written instructions, to ensure suitability and desired results.
- C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of graffiti-resistant coating. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of graffiti-resistant coating being deposited on surfaces. Cover live plants and grass.

- D. Coordination with Sealants: Do not apply graffiti-resistant coating until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, graffiti-resistant coating, and sealant materials identical to those used in the work.
- E. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.
 - 1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

3.2 APPLICATION

- A. Apply a spray, roller or brush applied coating of graffiti-resistant coating on surfaces indicated for treatment using equipment complying with manufacturer's written instructions.
- B. Apply a second coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

3.4 CLEANING

- A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.
- B. Immediately clean graffiti-resistant coating from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 10 14 23.13
ROOM-IDENTIFICATION SIGNAGE

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 room-identification signs that are directly attached to the building.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, tpestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available tpestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
 - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 3. Exposed Accessories: Full-size Sample of each accessory type.
 - 4. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign Insert drawing designation: Sign Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 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. ACE Sign Systems, Inc.
 - b. Advance Corporation.
 - c. Allen Industries Architectural Signage.
 - d. APCO Graphics, Inc.
 - e. ASE, Inc.
 - f. ASI Sign Systems, Inc.

- g. Best Sign Systems, Inc.
 - h. Clarke Systems.
 - i. InPro Corporation (IPC).
 - j. Mohawk Sign Systems.
 - k. Nelson-Harkins Industries.
 - l. Seton Identification Products.
 - m. Signature Signs, Inc.
 - n. Vista System.
 - o. Vomar Products, Inc.
2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Minimum 0.125 inch .
 - b. Surface-Applied Graphics: Applied vinyl film.
 - c. Color(s): As selected by Architect from manufacturer's full range.
 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: As indicated on Drawings.
 - b. Corner Condition in Elevation: As indicated on Drawings.
 4. Mounting: Surface mounted to wall with adhesive two-face tape.
 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209 , alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- C. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:

- a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
- 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
- B. Adhesive: As recommended by sign manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls .
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 28 13
TOILET LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - a. Combination toilet tissue/seat-cover dispenser, recessed mounted.
 - b. Automatic paper towel (roll) dispenser, semirecessed.
 - c. Grab bar with concealed fastener mounting flanges.
 - d. Mirror unit.
 - e. Coat hook.
 - f. Soap dispenser, undercounter mounted.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.5 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials: Products indicated on Drawings as OFOI.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product specified below for each accessory type or comparable product by one of the following:
1. American Specialties, Inc.; ASI Group.
 2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corporation.
 4. Brey-Krause Manufacturing Co.
 5. GAMCO Specialty Accessories; a division of Bobrick.
 6. Sloan Valve Company.
 7. Tubular Specialties Manufacturing, Inc.
- B. Combination Toilet Tissue/Seat-Cover Dispenser, Recessed Mounted:
1. Basis-of-Design Product: Bobrick B-30919.
 2. Description: Combination unit with double-roll toilet tissue dispenser and the following:
 - a. Seat-cover dispenser with minimum capacity of 500 single or half-fold seat covers.
 3. Mounting: Recessed.
 4. Toilet Tissue Dispenser Capacity: 4-1/2- or 5-inch- diameter tissue rolls.
 5. Toilet Tissue Dispenser Operation: Non-control delivery with theft-resistant spindles.
 6. Material and Finish: Stainless steel, No. 4 finish (satin).
 7. Lockset: Tumbler type.
- C. Automatic Combination Towel (Roll) Dispenser/Medium Waste Receptacle, Semirecessed Mounted:
1. Basis-of-Design Product: ASI 64696A-6.
 2. Description: Combination unit for automatic dispensing roll paper towels, with removable waste receptacle. Automatic motion sensing mechanism with user-adjustable delay and paper towel length; battery powered.
 3. Mounting: Semirecessed.
 4. Minimum Towel-Dispenser Capacity: 8-inch- wide, 800-foot- long roll.
 5. Minimum Waste Receptacle Capacity: 9.9 gal..
 6. Material and Finish: Stainless steel, No. 4 finish (satin).
 7. Lockset: Tumbler type for towel dispenser compartment and waste receptacle.
- D. Grab Bar with Concealed Fastener Mounting Flanges:
1. Basis-of-Design Product: Bobrick B-5806.
 2. Mounting: Flanges with concealed fasteners.

3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin).
 4. Outside Diameter: 1-1/4 inches.
 5. Configuration and Length: As indicated on Drawings.
- E. Mirror Unit:
1. Basis-of-Design Product: Bobrick B-165.
 2. Frame: Stainless-steel channel.
 - a. Corners: Manufacturer's standard.
 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 4. Size: As indicated on Drawings.
- F. Coat Hook:
1. Basis-of-Design Product: Bradley 9134-US.
 2. Description: Double -prong unit.
 3. Material and Finish: Stainless steel, No. 4 finish (satin).
- G. Soap Dispenser, Undercounter Mounted:
1. Basis-of-Design Product:

PART 3 - Insert manufacturer (select from list at beginning of this Article) and product at underscore line below.

PART 4 - Insert manufacturer (select from list at beginning of this Article) and product at underscore line below.

PART 5 - Products offered by manufacturers vary. Verify products offered by manufacturers, and revise product characteristics accordingly.

5.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

5.2 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 6 - EXECUTION

6.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

6.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION

SECTION 10 44 13 - FIRE PROTECTION CABINETS

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-protection cabinets for the following:
 - a. Portable fire extinguisher.
- B. Related Requirements:
 - 1. Section 10 44 16 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.3 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.
- D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- 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.

2.3 FIRE-PROTECTION CABINET <Insert drawing designation>

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **J.L. Industries, Inc. Ambassador Series Model 1816F10** or comparable product by one of the following:
 - a. Activar Construction Products Group, Inc. - JL Industries.
 - b. Babcock-Davis.
 - c. Fire-End & Croker Corporation.
 - d. GMR International Equipment Corporation.
 - e. Guardian Fire Equipment, Inc.
 - f. Larsens Manufacturing Company.
 - g. Modern Metal Products, Division of Technico Inc.
 - h. MOON American.
 - i. Nystrom.
 - j. Potter Roemer LLC; a Division of Morris Group International.
 - k. Strike First Corporation of America (The).
- B. Cabinet Construction: Nonrated where indicated on Drawings.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets where indicated on Drawings with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Steel sheet.

ICTC Calxico Intermodal Transit Center

FIRE PROTECTION CABINETS

- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- 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 projecting lever handle with cam-action latch.
 - 2. Provide continuous hinge, of same material and finish as trim, 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. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
 - 4. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated and as directed by Owner.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Comply with authorities having jurisdiction.
 - 4) Orientation: Vertical.
- K. Materials:
 - 1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.4 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.
 - 2. Miter corners and grind smooth.

3. Provide factory-drilled mounting holes.
 4. Prepare doors and frames to receive locks.
 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated.
 1. Fire-Protection Cabinet Mounting Height: As indicated on Drawings.
- B. Fire-Protection Cabinets: Fasten 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.
 3. Fire-Rated Cabinets:
 - a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.

- b. Seal through penetrations with firestopping sealant as specified in Section 07 84 13 "Penetration Firestopping."

C. Identification:

- 1. Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets 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 and mounting bracket manufacturers.
- 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 13

SECTION 10 44 16
FIRE EXTINGUISHERS

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 portable, fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 10 44 13 "Fire Protection Cabinets."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace 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 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. 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 FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International.
 - c. Badger Fire Protection.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - h. Kidde Residential and Commercial Division.
 - i. Larsens Manufacturing Company.
 - j. MOON American.
 - k. Nystrom, Inc.
 - l. Oval Fire Products Corporation.
 - m. Potter Roemer LLC.
 - n. Pyro-Chem; Tyco Fire Suppression & Building Products.
 - o. Strike First Corporation of America (The).
 2. Valves: Manufacturer's standard.
 3. Handles and Levers: Manufacturer's standard.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type Insert drawing designation: UL-rated 2A-10B:C, 5-lb nominal capacity; dimensions: 15.25-inches high x 7.5-inches wide x 4.25-inches deep , with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
1. Provide only for fire extinguishers shown to be wall mounted and not installed within fire extinguisher cabinets.
 2. 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. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International.
 - c. Babcock-Davis.
 - d. Badger Fire Protection.
 - e. Buckeye Fire Equipment Company.
 - f. Fire End & Croker Corporation.
 - g. Guardian Fire Equipment, Inc.
 - h. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - i. Kidde Residential and Commercial Division.
 - j. Larsens Manufacturing Company.
 - k. Nystrom, Inc.
 - l. Potter Roemer LLC.
 - m. Pyro-Chem; Tyco Fire Suppression & Building Products.
 - n. Strike First Corporation of America (The).
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION**
- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: Top of fire extinguisher to be at dimension above finished floor as indicated on Drawings.
 - B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 12 24 13
ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.
 - 2. Manually operated roller shades with double rollers.
- B. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
 - 2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
- E. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of shadeband material, signed by product manufacturer.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide manual roller shade systems by MechoShade Systems, Inc. or comparable product by one of the following:
 1. Draper Inc.
 2. Hunter Douglas Contract.
 3. Lutron Electronics Co., Inc.
 4. Nysan Solar Control Inc.; Hunter Douglas Company.
 5. OEM Shades Inc.
 6. Shade Techniques, LLC.

- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Bead Chains: Nickel-plated metal .
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount .
 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: In location recommended by fabricator. Indicate location for each shade on submittal for Architect's review.
 2. Direction of Shadeband Roll: Regular, from back of roller.
 3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Shadebands:
1. Material Orientation on Shadeband: Railroaded.
 2. Material: .
 - a. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1) Source: Roller-shade manufacturer.
 - 2) Type: PVC-coated polyester.
 - 3) Weave: Basketweave.
 - 4) Roll Width: 98 inches.
 - 5) Openness Factor: 3 percent.
 - 6) Color: EuroTwill - 6459 Silver Dove.
 3. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.
2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide manual roller shade systems by MechoShade Systems, Inc. or comparable product by one of the following:
 1. Draper Inc.
 2. Hunter Douglas Contract.
 3. Lutron Electronics Co., Inc.
 4. Nysan Solar Control Inc.; Hunter Douglas Company.
 5. OEM Shades Inc.
 6. Shade Techniques, LLC.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 1. Bead Chains: Nickel-plated metal .
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount .
 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under.
 2. Inside Roller:
 - a. Drive-End Location: In location recommended by fabricator. Indicate location for each shade on submittal for Architect's review..

- b. Direction of Shadeband Roll: Regular, from back of roller.
- 3. Outside Roller:
 - a. Drive-End Location: In location recommended by fabricator. Indicate location for each shade on submittal for Architect's review..
 - b. Direction of Shadeband Roll: Regular, from back of roller.
- 4. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.
- E. Shadebands:
 - 1. Material Orientation on Shadeband: Railroaded.
 - 2. Inside (Roomside) Material: .
 - a. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1) Source: Roller-shade manufacturer.
 - 2) Type: PVC-coated polyester.
 - 3) Weave: Basketweave.
 - 4) Roll Width: 98 inches.
 - 5) Openness Factor: 3 percent.
 - 6) Color: EuroTwill - 6459 Silver Dove.
 - 3. Outside (Windowside) Material: .
 - a. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
 - 1) Source: Roller-shade manufacturer.
 - 2) Type: Opaque. Acrylic backing, PVC-free, white color reverse side (for exterior).
 - 3) Roll Width: 98 inches.
 - 4) Features: Washable.
 - 5) Color: 0117 Graphie.
 - 4. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- F. Installation Accessories:
 - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.

2. Endcap Covers: To cover exposed endcaps.
3. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 22 05 00

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of basic materials and methods for plumbing Work as necessary to support Sections in Division 22, Plumbing, which specify particular categories of Plumbing Work.
- B. Contract Drawings are diagrammatic and do not show all offsets, fittings and accessories that may be required. Carefully investigate structural and finish conditions affecting Work, and furnish such fittings and accessories as required.

1.02 RELATED SECTIONS

- A. Section 03 30 00: Cast-in-Place Concrete
- B. Section 05 05 23: Welded stud Connectors
- C. Section 05 05 33: Basic Welding Requirements
- D. Section 07 62 00: Flashing and Trim
- E. Section 07 84 00: Fire Stopping
- F. Section 07 92 00: Joint Sealants
- G. Section 08 31 13: Access Doors and Floor Hatches
- H. Section 09 91 00: Painting and Coating
- I. Section 22 05 29: Pipe Sleeves, Supports, Guides and Anchorage
- J. Section 22 05 53: Plumbing Systems Identification
- K. Section 22 05 48: Vibration-Seismic Isolations for Plumbing
- L. Section 22 07 00: Plumbing Insulation
- M. Section 22 09 00: Instrumentation and Control for Plumbing
- N. Section 22 11 00: Water Supply System
- O. Section 22 13 00: Sanitary Sewer System
- P. Section 22 14 01: Storm Drainage System

Q. Section 22 33 00: Domestic Water Heaters

R. Section 22 40 00: Plumbing Fixtures

1.03 REFERENCES

A. American National Standards Institute (ANSI)

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI/ASME B16.3	Malleable Iron Threaded Fittings
ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings
ANSI/ASME B16.10	Face to Face and End to End Dimensions of Valves
ANSI/ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ANSI/ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME/ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI/ASME B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
ANSI/ASME B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings
ANSI/ASME B36.10	Welded and Seamless Wrought Steel Pipe

B. ASTM International

ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded, and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or Temperature Service
ASTM A307	Carbon Steel Bolts and Studs
ASTM A395	Ferrite Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures
ASTM A536	Ductile Iron Castings
ASTM B88	Seamless Copper Water Tube
ASTM C564	Rubber-Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C1277	Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
ASTM D256	Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D570	Water Absorption of Plastics
ASTM D638	Tensile Properties of Plastics
ASTM D695	Compressive Properties of Rigid Plastics

ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1785	Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2240	Rubber Property - Durometer Hardness
ASTM D2467	Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems
ASTM D2665	Poly Vinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D4414	Measurement of Wet Film Thickness by Notch Gages
ASTM D4541	Pull-off Strength of Coatings Using Portable Adhesion Testers
ASTM F656	Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
C. American Water Works Association (AWWA)	
AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	Ductile-iron and Gray-iron Fittings, 3 in. through 48 in., for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-iron Pressure Pipe and Fittings
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution
D. California Code of Regulations (CCR) Title 24	
E. Cast Iron Soil Pipe Institute (CISPI)	
CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drains, Waste and Vent Pipe Applications
CISPI 310	Couplings for Use in Connection with Hubless Cast iron Soil Pipe and Fittings for Sanitary and Storm Drains, Waste and Vent Pipe Applications
F. Federal Specifications (FS)	
FS GG-G-76	Gages, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil, Water, Ammonia, Chlorofluorohydrocarbon Gases and Compressed Gases)

- | | |
|-------------|---|
| FS WW-P-421 | Pipe, Cast Gray and Ductile Iron, Pressure (for Water and Other Liquids) |
| FS WW-U-531 | Unions, Pipe, Steel or Malleable Iron: Threaded Connection, 150 lb, 250 lb and 300 lb WSP |
- G. Department of Defense, Military Specifications (MIL)
- | | |
|-------------|---|
| MIL-S-16293 | Strainers, Sediment: Pipeline, Water, Air, Gas, Oil |
|-------------|---|
- H. Manufacturers Standardization Society (MSS)
- | | |
|-----------|---|
| MSS SP-70 | Cast Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-71 | Cast Iron Gate, Globe, Angle and Check Valves |
| MSS SP-72 | Ball Valves with Flanged or Butt-Welding Ends for General Service |
| MSS SP-80 | Bronze Gate, Globe, Angle and Check Valves |
- I. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- | | |
|-------------|---|
| SMACNA 2008 | Seismic Restraint Manual Guidelines for Mechanical Systems. |
|-------------|---|
- J. National Fire Protection Association (NFPA)
- | | |
|---------|--------------------------------|
| NFPA 70 | National Electrical Code (NEC) |
|---------|--------------------------------|
- K. California Building Code; Fire Code and Plumbing Code
- L. County of Los Angeles Building Code; Fire Code and Plumbing Code
- M. NSF International
- | | |
|--------|---|
| NSF 61 | Drinking Water System Components - Health Effects |
|--------|---|

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).
- B. Install Work in accordance with Specifications and instructions provided by equipment suppliers. Use installers qualified in accordance with following requirements:
 - 1. Plumbers and pipe fitters - Under direct responsible supervision of a plumber licensed by State of California.
- C. Perform checks, inspections, pretest and tests in accordance with specifications and instructions from equipment suppliers. Perform testing under the observation, and to the approval, of Contractor's QC Representative. Notify Contractor's QC Representative at least three days before the tests.

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal procedures.

- B. List of Materials - Before start of plumbing work, complete list of materials and equipment proposed. Give name of manufacturer, brand name and catalog number of each item. Submit list complete at one time with items arranged and identified in numerical sequence by Specification Section and Paragraph number.
- C. Evidence of Compliance with Standards - Where equipment or materials are specified to conform to standards of organizations, submit evidence of conformance to Contractor's QC Representative before installation. Label or listing of specified agency will be acceptable evidence. Instead of label or listing, Contractor may submit a written certificate from an acceptable, nationally recognized testing organization that is adequately equipped and competent to perform such services, stating items have been tested and units conform to specified standard.
- D. Coating Materials
 - 1. Furnish manufacturer's certificate of compliance for coating materials. Include in certificate, material identification, and other laboratory data covering requirements of specifications under which material is being furnished.
 - 2. Manufacturer's application and repair instructions.
- E. Seismic Restraint Design - Seismic analysis and design for equipment, and pipe, shall be stamped and signed by a professional civil or structural engineer registered in the State of California.
- F. Factory Test and Inspection Certification
 - 1. Except as otherwise specified, where factory tests and inspections for materials and equipment specified in referenced documents are waived, provide certified copies to Contractor's QC Representative of reports for tests performed on previously manufactured identical materials and equipment within previous 12 months.
 - 2. Include with test reports and signed statements from manufacturer certifying previously tested material or equipment is physically, mechanically and electrically identical to that proposed for Project. Include wiring and control diagrams.
- G. Shop and Working Drawings - Show complete details of following for installation of plumbing equipment and materials.
 - 1. Embedment locations for equipment mounting.
 - 2. Information for setting bolts in foundations and housekeeping pads.
 - 3. Mounting methods showing adjustment and alignment.
 - 4. Pipe anchors; supports and guides.
 - 5. Details of installation of temporary materials and equipment used for Work.
 - 6. Layout and complete details for piping.
 - 7. Plan for performing Work; including sequence of operations.
 - 8. Seismic restraint details and locations.
 - 9. Information for setting concrete inserts in sump walls and floors.

- H. Installer's Qualification - Certification of qualification of workers installing plumbing equipment.
 - 1. Plumbers and fitters.
- I. Manufacturer's Product Data including those for seismic restraint devices.
- J. As-Built Drawings - Maintain up-to-date, legible, accurate, dimensioned reproducible record of As-Built location of Work as installed under this Contract for review and approval. As-Built Drawings are required to receive approval when review of Work completed.
- K. Corrosion Control Information including catalog cuts and specifications for the following:
 - 1. Non-toxic moisture tolerant 100 percent solids epoxy coating for interior surfaces of insulating fittings.
 - 2. Insulating flange kits for piping.
 - 3. Insulating unions for piping.
 - 4. Tape-wrap system for buried pressurized pipe.
- L. Totalizer System test report.

1.06 DEFINITIONS (NOT USED)

1.07 DELIVERY, STORAGE AND HANDLING

- A. Protecting Machined Surfaces - Apply rust preventive on machined surfaces including flanges and shafts. Use type of material easily removable with solvent during equipment installation.
- B. Covering Openings - Close pipe connections and other openings with easily removable plugs, stoppers or flange covers.
- C. Protecting Coated Surfaces
 - 1. Prevent damage to protective coating during storage and delivery. Keep wire ropes, chains and hooks from direct contact with coated surfaces. Pad saddles, bolsters, loading stakes and other devices that will bear against coated surfaces with approved materials.
 - 2. Provide sufficiently wide belt slings free from protruding rivets and bolts; prevent damage to coating.
 - 3. Nest or sufficiently pad stacked coated pipe so that adjacent pipe lengths bear equally against each other throughout coated lengths. Avoid excessively high stacking of coated pipe.

1.08 WORKSITE CONDITIONS

- A. Visit Worksite, thoroughly check details of Work and working conditions, verify dimensions in field, and advise Contractor's QC Representative of discrepancies before

performing Work. Verify that sump coatings have been applied and cured prior to performing work in those areas: refer to Paragraphs C and D below. Coordinate relation of Work to structure and to work of other trades and contracts through Contractor's QC Representative.

B. Protective Pipe Coatings Environmental Requirements - Apply exterior coating only during favorable conditions of temperature and humidity.

1. Provide heated working enclosures when ambient or substrate temperature is lower than manufacturer's recommended temperature.
2. Apply coating when relative humidity is less than 90 percent and substrate temperature is not less than 5 deg F above dew point.
3. Apply coating in accordance with manufacturer's recommendations.

C. Coatings

1. Chemical Resistance - Coating shall resist the effects of dirty water, commercial floor and wall cleaners, dilute household bleach, and domestic waste.
2. Coating shall form a watertight barrier between the contained liquid and the concrete substrate.
3. Coating shall be capable of being applied to both horizontal and vertical surfaces. The same coating shall be applied to both the horizontal and vertical surfaces of the sump. The same coating shall be applied to all sumps.
4. Thickness - Coating thickness shall be a minimum of 1/8 inch.
5. Color - Manufacturer's standard.

D. Physical Characteristics

1. Compressive Strength - 4300 psi per ASTM C579.
2. Flexure Strength - 1200 psi per ASTM C580.
3. Modulus of Elasticity - 30,900 psi per ASTM C580.
4. Tensile Strength - 1500 psi per ASTM C531.
5. Bond Strength - Greater than 250 psi (100% concrete failure) per ASTM D4541.
6. Absorption - Less than 0.03 percent per ASTM C413.

E. Surface - Coating shall have a non-skid surface.

PART 2 - PRODUCTS

2.01 STANDARD PIPE AND FITTING CLASSES

A. Service applications for following classes of pipe and fittings are specified in other Sections of these Specifications, or indicated. Where more than one class is indicated in same run, either class may be used, but do not intermingle classes. Dimensions of steel pipe shall comply with ANSI B36.10, unless otherwise specified.

B. Class A – Not Used

C. Class B

1. Pipe and Fittings - Service weight, plain end hubless cast iron soil pipe and fittings shall conform to CISPI 301.
2. Joints shall be no-hub coupling consisting of knurled stainless steel shield and clamp assembly, and a molded one-piece Neoprene sealing sleeve. Joints shall conform to ASTM C1277 and CISPS 310.

D. Class C

1. Pipe - ASTM B306, Type DWV, hard copper drainage tube.
2. Fittings – ANSI B16.29, wrought copper or bronze solder-joint drainage fittings.

E. Class D

1. Pipe - ASTM B88, Type K, hard copper tubing.
2. Fittings - ANSI B16.18 cast bronze solder fittings, or ANSI B16.22 wrought copper solder fittings and couplings.
3. Joints - Silver-brazed.

F. Class E

1. Pipe - ASTM B88, Type L, hard copper tubing.
2. Fittings - ANSI B16.18 cast bronze solder fittings, or ANSI B16.22 wrought copper solder fittings and couplings.
3. Joints - 95-5 lead free solder.

G. Class F – Not Used

H. Class G

1. Pipe - Polyvinyl chloride (PVC), ASTM D1785, Schedule 80, Type 1, Grade 1.
2. Fittings - Socket cement, same material and schedule as pipe. ASTM D1785, as applicable per local codes.
3. Joints - Socket cement using PVC solvent cement and primer, ASTM D2564

I. Class H – Not Used.

J. Class I – Not Used.

K. Class J

1. Three Inches and Smaller
 - a. Pipe - ASTM A53, Type E, or S, Grade A or B, Schedule 40, black steel, threaded ends.
 - b. Fittings –ANSI B16.3, Standard weight malleable iron threaded fittings
 - c. Joints - Threaded
 - d. Unions - ANSI B16.3, malleable iron, threaded.

2. Four Inches and Larger

- a. Pipe - AWWA C151, 150 pound pressure class, ductile iron pipe coated outside with bituminous material and lined with cement mortar of double standard thickness as per AWWA C104. Coat cement lining with nontoxic bituminous material. Cement for mortar lining on sump pump discharge lines - Type V.
- b. Fittings - AWWA C110, Class 250, and cement lined per AWWA C104.
- c. Joints - AWWA C111, mechanical restrained joints with neoprene gaskets.

L. Class K – Not Used.

M. Class L – Not Used.

N. Class M – Not Used.

O. Class N

1. Pipe - ASTM A53, Type E, F or S, Grade A or B, Schedule 40, black steel, threaded or flanged ends, or cut grooved ends for grooved flexible couplings.
2. Fittings
 - a. ASME B16.3, standard weight malleable iron threaded fittings.
 - b. ANSI B 16.9 or ANSI B16.25 steel Buttwelding fittings.
 - c. ASME B16.5, steel pipe flanges and flanged fittings.
 - d. Steel grooved end fittings and gaskets for grooved pipe - Withstand 230 deg F for one hour without failure. Coupling - Allows up to 0.25-inch expansion and contraction, and allows greater than zero degree deflection.
3. Joints
 - a. Two inches and smaller - Threaded.
 - b. Larger than two inches - Flanged or cut grooved as indicated.
4. Unions
 - a. Two inches and smaller - ANSI B16.3, malleable iron, threaded.
 - b. Larger than two inches - Flanged.
5. Flanges - ASME B16.5 and ASTM A181, Grade I, forged steel raised or plain face, 150-pound class.

P. Class O

1. Pipe - ASTM A53, Type E, F or S, Grade A or B, Schedule 40, galvanized steel.
2. Fittings - ANSI B16.11, threaded, galvanized steel, minimum 175 psi water Working pressure.

Q. Class P

1. Pipe – ASTM B88, Type L, soft copper tubing.
2. Fittings – ANSI B16.18 cast bronze solder fittings, or ANSI 816.22 wrought copper solder fittings and couplings.

3. Joints – 95-5 lead free solder

2.02 BRANCH TEES

- A. Copper Tubing - Brazing outlets, with branch size at least two sizes smaller than main.

2.03 PIPE JOINT MATERIAL

- A. Solder - ASTM B32 composition Sn 95 with type IS flux.
- B. PVC Solvent Cement - ASTM D2564.
- C. PVC primer – ASTM F656.

2.04 VALVES

- A. Gate Valves
 1. Two inches and smaller: 150-pound, bronze, replaceable seat and disc, threaded connection.
 2. 2 1/2 inches and larger: 125-pound, iron body, non-rising stem, wedge disc, flanged connection; MSS SP-70.
- B. Check Valves
 1. Swing Check, two inches and smaller: 150-pound, bronze threaded connection, with removable hinge pin and screwed cap. suitable for operation in horizontal or vertical position, per MSS-SP-80.
 2. Swing Check, 2 1/2 inches and larger: 125-pound, suitable for horizontal and vertical installation; cast iron body conforming to ASTM A126, with flat-faced flanged ends conforming to ANSI B16.1 and B16.10, and brass hinge pins and bronze trim, per MSS-SP-71.
 3. Silent Check - Globe type, 150-pound, iron body, with disc guided top and bottom, bronze trimmed seat and plug, stainless steel spring, flanged connection, per MSS-SP-71.
- C. Ball Valves - Lever-operated, 400 psig WOG (minimum), bronze or brass ball and stem. With minimum two piece bronze body having ends to suit installation. Provide with full round port. Provide stem extension where installed in insulated piping.
- D. Compression Stops
 1. Exposed Water Supplies to Fixtures - Polished, chrome-plated, loose key brass stop.
 2. Concealed Supplies to Fixtures - Provide ball valve within accessible pipe chase or other adjacent access area or space.
 3. Exposed Supplies at Hose Bibs: Provide ball valve.
- E. Relief Valves
 1. Pressure and temperature relief for hot water supply systems. MIL-V-13612.

2. ASME rated for intended service - Single-seated, bronze body and trim, guides, and threaded connections.

F. Hose Bib - In accordance with Section 22 40 00, Plumbing Fixtures.

2.05 UNIONS

A. Galvanized Steel Pipe:

1. Two inches and smaller - Galvanized with brass or bronze seats, 150-pound, malleable iron, threaded.

B. Copper or Brass Pipe or Tubing.

1. 3/8 inch and smaller: 150-pound, cast bronze or copper, ground joint, non-ferrous seat, with solder ends.

C. Copper or Brass Pipe:

1. 1/2 inch to two inches - Cast brass, 150-pound, ground joint, brass-to-brass seat, with threaded or solders ends.

D. Black and Nickel-Copper Alloy Steel Pipe:

1. 2-1/2 inches and larger - Forged steel, 150 pound, raised face, slip-on or weld neck to suit field fit up.

2.06 FLANGES

A. Ductile Iron Pipes - ANSI A21.14, 250-pound, flat face, cast iron flanges for mechanical joints. ASTM A307, Grade B, bolts and nuts. Bolts - Regular square head, unfinished. Nuts - Heavy semi-finished hexagon nuts conforming to ASTM A194, Grade 2H.

B. Copper, Bronze or Brass Pipe - ANSI B16.24, 150-pound, cast bronze, flat-faced with solder ends, 2-1/2 to 12 inches.

C. Provide stainless steel nuts, bolts and washers for buried flanges and couplings, except provide nonmetallic washer as part of insulating flange set.

2.07 GASKETS

A. Cold Water Service: 1/16 inch thick for the pressure class and type of joint.

B. Hot Water Service - Compressed aramid, 1/16 inch thick.

C. Soil, Waste, Vent and Drain - Neoprene rubber as required for type of pipes used, cellular elastomeric preformed gasket and sealing material.

2.08 INSULATING CONNECTIONS

- A. Provide insulating flanges or unions suitable for intended operating pressure and services as required, constructed so that connected pipes are electrically isolated from each other by die-electrical insulating material.
- B. Flange insulating kits - Flat center gasket, insulating sleeves and insulating washers as specified below.
- C. Provide center gasket with same outer diameter as flange, and constructed of neoprene faced phenolic, 1/8 inch thick. Inside diameter of center gasket: 1/4 inches smaller than inside diameter of flange bore.
- D. Construct insulating sleeves of phenolic, 1/8 inch overall thickness, of sufficient length to extend through two flat faced flanges, center gasket and insulating washers.
- E. Make insulating washers of high strength phenolic, minimum 1/8 inch thick with dielectric strength compatible with minimum values of insulating sleeves and gaskets. Furnish double quantity of insulating and steel washers for full insulation flanges.
- F. Coat pipe interior with moisture-tolerant, 100 percent solids epoxy-resin system epoxy for distance two times pipe diameter on both sides of flange.
- G. External coating for buried insulating flanges - Wrap around flange-to-pipe transition with wax tape system.
- H. Insulating Unions - Provide with insulating sleeve and gasket. Limits use of insulating unions to non-buried applications.
- I. PVC Insulating Insert: 18 inch plain end length of PVC pipe in accordance with AWWA C900. Limits use of PVC pipe inserts as insulators to buried applications at locations indicated.
- J. Insulating couplings will not be acceptable.

2.09 STRAINERS

- A. MIL-S-16293, Class 125, Style Y, Type I or III.

2.10 PROTECTIVE COATING FOR BURIED METALLIC PIPING

- A. Provide protective coating on buried metallic piping. Provide protective coating on pressurized ferrous piping in or under a concrete slab that rests on the ground. Provide protective coating on other metallic piping in an accepted submittal.
 - 1. Buried metallic piping is metallic piping covered with or resting on a bed of material other than Class 4000 concrete provided under Section 03 30 00, Cast-in-Place Concrete.
 - 2. Embedded metallic pipe-Metallic pipe covered with Class 4000 concrete provided under Section 03 30 00, Cast-in-Place Concrete. Do not coat embedded metallic pipe, unless a coating is required as indicated or pressurized ferrous piping is

installed in or under a concrete slab that rests on the ground (see above). Wrap embedded metallic pipe except where tape coating is required in this specification Article: refer to Article 2.21, Pipe Wrapping in this section.

3. Exposed metallic pipe is metallic pipe exposed to air on all sides and rests on or suspended by engineered supports. Do not coat exposed metallic pipe, unless a coating is required in another Section or Contract Drawing.

B. Pressurized Pipe

1. Tape - Composite system with outer layer of polyethylene or PVC not less than five mils thick and an inner layer of synthetic elastomer not less than 35 mils thick, conforming to following requirements:
 - a. Maximum Moisture Transmission Rate: 0.06 gram/100 square inches/24 hours.
 - b. Maximum Moisture Absorption: 0.05 percent.
 - c. Operating Temperature Range: - 40 deg F to 180 deg F.
 - d. Application Temperature Range: - 30 deg F to 120 deg F.
 - e. Dielectric Strength: 15,000 volts, minimum.
 - f. Volume Resistivity: 10¹¹ ohm-cm, minimum.
 - g. Primer - Specifically compounded for tape used.
2. Insulating Flange Interior Lining - Two-part, moisture-tolerant, 100- percent two component liquid amine-cured epoxy-resin system suitable for use in potable water systems, conforming to NSF 61 and the following:
 - a. Mix Ratio 1.1
 - b. ASTM D695 Compressive Strength 4,175 psi
 - c. ASTM D638 Tensile Strength 2,700 psi
 - d. ASTM D790 Flexural Modulus 7.9X10⁶ psi
 - e. ASTM D2240 Type D Hardness 87
 - f. ASTM D4541 Bond Strength-concrete >350 psi
 - g. Pot Life after Mixing, Minimum 40 minutes

- C. Non-Pressurized Pipe - Provide polyethylene encasement in accordance with AWWA C105.

2.11 GAUGES

- A. FS GG-G-76, sizes as indicated, and with gauge cock.
- B. Calibration - Calibrated to two percent in middle 1/3 of dial range and equipped with means of calibration.
- C. Movements- Phosphor bronze bushed rotary type.
- D. Panel Mounted - Flush mounting type in stainless steel, phenolic or aluminum cases.

- E. Stem or Pipe Mounted - Flangeless cases of drawn or stamped steel, phenolic or aluminum.

2.12 ACCESS PANELS

- A. Furnish prefabricated wall and ceiling panels for service access to plumbing equipment. Refer to Section 08 31 00, Access Doors and Panels.
- B. Size - Large enough to permit removal of equipment; not less than 12 by 12 inches net opening. Where entrance of serviceman is required, provide minimum opening of 24 by 24 inches.
- C. Construction - As specified in Section 08 31 00, Access Doors and Panels.
- D. Furnish panel(s) to appropriate trade(s) for installation

2.13 WALL PENETRATION INSULATORS AND SLEEVES

- A. Refer to Section 07 84 00, Fire Stopping, for fire stop materials and installation; Section 07 62 00, Flashing and Trim, for flashing materials and installation; and Section 07 92 00, Joint Sealants, for Joints, except as otherwise indicated.
- B. Sleeves through Interior Walls, floors, and ceilings
 - 1. Sleeves - Provide pipe conforming to ASTM A53. Weld steel plate anchor conforming to ASTM A36 to pipe as indicated. Hot-dip galvanized assembly after fabrication.
 - 2. Packing - Where pipes pass through fire-rated walls, floors or ceilings, provide fire-stop material to seal opening between pipe and sleeve. For other penetrations, provide sealing material.
 - 3. Escutcheons - As specified for piping system penetrating sleeve.
- C. Sleeves through exterior below-grade walls; floors and ceilings with an exterior sealing membrane.
 - 1. Sleeves more than 15 feet below grade (Type H) - Cast iron, ASTM A74, pressure sealing with membrane clamp; cast iron body with external fins, internal steel compression rings and nitrile rubber grommets, and pressure clamp with 18-8 stainless steel bolts; nonconductive pipe sleeve between cast iron body sections; oversize steel sleeve with neoprene sealing rings and coating as indicated. Sealing members - Provide electrical isolation between carrier pipe and metallic components of sleeve including membrane and pressure clamps.
 - 2. Sleeves 15 feet or less below grade (Type L) - Steel pipe sleeve, ASTM A53, pressure sealing with membrane clamp ring, gasket, water-stop ring, external rings, internal dielectric compression plates, nitrile rubber link seals and coating on metal parts as indicated.
 - a. Seals - Modular mechanical type seals, consisting of interlocking nitrile rubber links shaped to continuously fill annular space between pipe and sleeve and electrically isolate carrier pipe from the steel sleeve.

- b. Sealing element - Nitrile rubber material compounded to resist aging, ozone, sunlight, hydrocarbon gases, water and chemical action.
 - c. Hardware - Type 18-8 stainless steel fasteners. Threads rolled to produce smooth uniform threads and unbroken flow lines.
 - d. Compression plates - Plastic, injection molded for high physical properties, dielectric strength and non-cold flow creep characteristics, with high resistance to acidic and alkaline soils.
- D. Sleeves through exterior above-grade walls, floors and ceilings without an exterior sealing membrane.
- 1. Sleeves - Steel pipe sleeves, ASTM A53.
 - 2. Seals - Modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between carrier pipe and metallic sleeve and electrically isolate carrier pipe from sleeve and glass reinforced nylon pressure plates.
- E. Sleeves through exterior above-grade roofs - Provide one of following:
- 1. Lead flashing sleeve weighing four psf, or copper sleeve weighing 16 ounces per square foot, suitably framed with skirt extending not less than eight inches.
 - 2. Cast iron sleeve with caulking recess, anchor lugs, flashing clamp device and pressure ring with brass bolts.
- F. Insulating Wall Sleeves
- 1. Where buried pressurized metallic piping systems penetrate vault walls, at-grade floor slabs and other locations indicated without exterior sealing membrane, provide sleeves with mechanical type insulating seals. Modular seals - Interlocking synthetic rubber links shaped continuously to fill annular space between carrier pipe and metallic sleeve and electrically isolate carrier pipe from sleeve. Pressure plates for seals - Glass reinforced nylon.
 - 2. Where buried pressurized metallic piping systems penetrate exterior below-grade walls, floors and ceilings with an exterior sealing membrane, provide sleeves with insulating type seals as specified in this section.
- G. Casing Sleeves
- 1. High density, injection molded polyethylene casing sleeves with following properties:
 - a. Compressive strength (ASTM D695) - 3200 psi
 - b. Tensile strength (ASTM D638) - 3100-5500 psi
 - c. Water absorption (ASTM D570) - 0.1 percent
 - d. Impact strength (ASTM D256) - 1.5-4.0 ft-lb/in. of notch
 - 2. Casing sleeves for metallic carrier pipe inside a metallic casing - Insulating type designed to provide electrical isolation between carrier pipe and casing.
- H. Casing End Seals

1. Provide modular type mechanical casing seals consisting of interlocking synthetic rubber links shaped to fill annular space between pipes and casing and nonconductive pressure plates, or external pull-on type synthetic rubber casing seals banded to casing and carrier pipe. Size seals in accordance with manufacturer's requirements for particular size of carrier pipe and casing involved; ensure a watertight seal.
2. Modular type mechanical seals and pull-on type seals for metallic carrier pipe inside a metallic casing - Insulating type designed to provide electrical isolation between carrier pipe and casing.

2.14 CASINGS FOR BURIED PIPING

- A. Class D pipe.

2.15 SEISMIC RESTRAINT

- A. Provide seismic restraints for plumbing equipment and pipes provided or installed under Division 22 Plumbing Sections.
- B. Plumbing equipment seismic restraints shall comply with California Building Code 2019, as modified by California Administrative Code Title 24.
- C. Provide pipe seismic restraints in accordance with SMACNA 2008.

2.16 TOTALIZER SYSTEM

- A. Provide totalizer system that includes totalizer meter, flow sensor, appurtenances, fittings, and hardware. Include provisions for remote indication, of water flow/no flow in the form of voltage-free contact closure brought out to the terminal strip.
- B. Totalizer Meter – Non-resetable, UL listed, microprocessor controlled, 8-digit, alpha-numeric, aircore meter movement. Accuracy: + 0.1 percent. Repeatability: +/- 0.5 percent of full range. Update rate of one second, maximum. Dial face: 5 inches diameter.
- C. Flow Sensor - Provide UL Listed paddlewheel type flow sensor that is compatible with the totalizer meter and has the following performance with 68 deg F water: Range 1 to 20 feet per second; Linearity +/- 1% of full range; and Repeatability ÷ 0.5 percent of full range. Rated for 150 psi. Stainless steel Type 316 housing and paddle. Paddlewheel appropriate for pipe size. Wire terminals permanently identified. Provide flow sensor that can withstand without damage or malfunction, sudden reversals of water flow caused by the On/Off operation of pumps [Section 22 13 21, Sump Pumps (Plumbing), and Section 22 13 00, Sanitary Sewer System (Plumbing)].
- D. Appurtenances:
 1. For Totalizer Meter - Corrosion proof NEMA 4/1P65 enclosure for totalizer meter, per Division 26. Include terminal strip permanently marked to correspond to Contract Electrical Drawing requirements. If required, provide 120 Vac 60 Hz step down transformer inside enclosure.

2. For Flow Sensor - NEMA 4 corrosion proof enclosure with knockouts or equivalent for one inch conduit termination. Include saddle or equivalent fitting and wet-tap or equivalent assembly for cleaning sensor without pump system shutdown.
3. Wire and Wireway -Provide shielded twisted-pair signal wire and metallic wireway from flow sensor to totalizer meter.

2.17 PIPE WRAPPING

- A. Provide protective pipe wrapping on all embedded metallic piping except where protective coating is provided under Article 2.10, Protective Coating for Buried Metallic Piping, in this section.
 1. Polywrap: 8 mil tubular polyethylene tube. Acceptable manufacturer: Northtown Company.
 2. Protection Tape: PVC tape with adhesive, all meeting IAPM0 PS 37-90. Acceptable manufacturer: Pasco.
- B. At Contractor's option, protective coating may be used in place of pipe wrapping.

PART 3 - EXECUTION

3.01 PROTECTION OF THE WORK

- A. Cover openings in piping and temporarily seal to protect from contamination.
- B. Protect materials and equipment from damage due to environmental conditions. Use protective cover, and protect from surface water by using raised platforms.
- C. At end of each workday, protect unfinished work from damage, contamination and moisture by use of plugs, caps or covers.
- D. Protect piping and valves from damage pending performance of system tests.
- E. Protect installed thermometers and gauges from accidental damage by construction activity.
- F. Following installations, and before final embedment, use temporary protective covers and fixtures to prevent damage or displace embedments from traffic and overburden loads.
- G. Clean fixtures, piping, valves, finished brass and equipment installed under this Work. Drain and flush piping to remove grease and foreign matter.

3.02 LOCATIONS OF FIXTURES AND EQUIPMENT

- A. Plumbing sheets of Contract Design Drawings are diagrammatic and not intended for use in determining exact locations of components of mechanical and electrical systems. Install per approved Shop Drawings.

- B. Determine exact locations plumbing of fixtures and equipment installed under this Contract, based on Design and Shop Drawings.
- C. Install plumbing system components at exact location indicated on plumbing Shop Drawings.

3.03 INSTALLATION OF PIPING

- A. Install piping parallel to walls, unless indicated otherwise. Clear obstructions, preserve headroom, and keep openings and passageways clear.
 - 1. If structural features or other work prevent running pipes or setting equipment at locations indicated, necessary minor deviations will be allowed, subject to review and approved by Contractor's QC Representative.
 - 2. Run piping in chases or recesses in walls where provided, through openings in floors, and in furred ceilings; otherwise, as exposed pipes. Do not embed piping in or below structure, except as indicated.
 - 3. Expanding or swaging of tubing to fit IPS fitting sockets will not be permitted.
 - 4. Use reducing fittings where change in pipe size occurs.
 - 5. Use couplings only where required pipe runs between fittings are longer than standard length of pipe being used.
 - 6. Make connections to exposed polished or enameled fixtures or equipment with special care to avoid damage to finished surfaces.
 - 7. Make changes in direction with fittings. Exception: soft copper tubing may be bent per accepted trade practices where no fillings are permitted, i.e. embedded locations where noted.
 - 8. Use proper length bolts for each size flange on flanged connections. Bolts with excessive length of exposed threads will not be permitted. Provide a minimum of three full threads exposed beyond nut after tightening assembly.
 - 9. Prevent entry of foreign matter during handling, assembling and installation. Use compressed air, wire brush, solvent and other acceptable means to remove scale, dirt and other foreign matter from interior of piping before final connections are made. Protect open ends of pipe by capping, plugging or other acceptable means.
 - 10. Anchor piping subject to expansion or contraction in a manner permitting strains to be evenly distributed and alleviated by swing joints or expansion loops.
 - 11. Ream pipe ends to remove burrs.
 - 12. Install piping with sufficient pitch to ensure adequate drainage and venting.
 - 13. Provide unions or flanges in piping connections to equipment.
 - 14. Electrically isolate pipe connections as specified under Section 26 42 00, Cathodic Protection.
 - 15. Install piping class as indicated or specified.
 - 16. Do not run water piping over electric switchboards. transformers or electric motor starters.

17. Install protective coatings and pipe wrappings.
 18. Coordinate painting of above grade ferrous piping. Painting to be provided under Section 09 91 00, Painting. Do not paint galvanized, buried and embedded ferrous pipes.
 19. Steel casing to be provided when plumbing piping crosses tracks. See Section 33 05 23, Steel Casing, Sub-section 2.01, for piping specification and installation.
- B. Steel Pipe with Grooved connections - Cut grooves into pipe and install grooved type couplings, fittings and pipe in accordance with manufacturer's instructions.

3.04 INSTALLATION OF PIPE JOINTS AND CONNECTIONS

- A. Cut pipe with appropriate tool and debur. Make joints tight. Test and remake leaky joints with new materials. Do not use thread cement or caulking to remake joints. Do not use a sharp toothed wrench in making up brass pipe or chrome-plated items.
1. Provide thread forms and length in accordance with ANSI standards. Use a lubricant or sealant on male threads suitable for proposed pipe service.
 2. Clean joint before soldering, and use appropriate flux and alloy for operating temperature level as indicated.
 3. Install solvent-cement joints for PVC pipe in accordance with manufacturer's recommendations.
 4. Coat gasket with recommended lubricant between contact faces of flanges.
- B. External Polyethylene Encasement - Encase buried cast iron soil pipe in a continuous polyethylene sleeve.
- C. Copper Tubing Systems
1. Not used.
 2. Make joints with 95.5 lead free solder.
 3. Clean outside of tube and inside of fitting at point of contact before joining. Take care to prevent overheating of tube and fitting before joining. Before soldering, disassemble solder type valves and keep valve bodies cool by use of damp cloths or other approved methods when recommended by valve manufacturer.
- D. Ductile iron Mechanical Joint Water Pipe – Install per manufacturers published instructions.
- E. Drain Connections
1. Make threaded joints with graphite or inert filler and oil, or tape of type recommended by pipe and fitting manufacturer, applied to male threads only.
 2. Make joints as specified for connecting pipe.
- F. Polyvinyl Chloride Pipe

1. Threaded joints - Make joints with pipe joint compound, or tape of type recommended by pipe and fitting manufacturer, suitable for service in which it is used, conforming to ANSI B1.20.1.
2. Flanged joints - When required, flanged joints may be used to connect to equipment or to other piping materials. Flanged, socket type molded PVC heavy 150-pound pattern, drilled per ANSI B16.5.
3. Cemented joints - Use solvent cement and primer of types recommended by fitting manufacturer, suitable for service in which used.

3.05 VALVES

- A. Provide valves at points shown and specified; arrange to give complete and regulating control of piping systems. Provide valves full size of line in which installed, unless otherwise indicated. Install valves with neat appearance and grouping, so parts are easily accessible for operation and maintenance.
- B. Install ball valve, stop valve, or a compression stop on water supply lines to each plumbing fixture, including faucets and hose bibbs. Where required for accessibility, install exposed adjacent to faucets. Where fixture trim is specified with integral built-in stops, individual supply stops will not be required.
- C. Manual Air Vent Assemblies - Provide at high points and other points necessary to free piping system of air.
- D. Check Valves - Provide swing check valves unless otherwise indicated.

3.06 UNIONS, FLANGES AND GASKETS

- A. Unions - Provide unions where indicated and at each threaded or soldered connection to equipment, tanks and valves, with following exceptions:
 1. One union required at each manually operated threaded valve.
 2. None required at compression stops.
- B. Locate unions so piping can be easily disconnected for removal of equipment, tank or valve.
- C. Flanges - Provide flanges at each flanged connection to equipment, tanks and valves. Provide matching flange faces at each connection. Install gaskets of required types. Tighten fastener system to manufacturer's recommended torque.

3.07 CORROSION CONTROL MEASURES, BURIED METALLIC PIPE

- A. This Paragraph covers buried, pressurized metallic piping including dry standpipe, wet standpipe, and fire protection piping.
- B. Protective Coating - Apply protective tape coating system as specified in Article 2.10, Protective Coating for Buried Metallic Piping in accordance with specified requirements and manufacturer's recommendations.

1. Shop coat line pipe.
2. Preparation of Pipe - Remove rust, rust preventatives, oil, moisture and other foreign matter from surface of pipe to be coated using a power wire brush or other suitable method reviewed and approved by Contractor's QC Representative. Apply primer to pipe in accordance with manufacturer's recommendations.
3. Spirally wrap metallic pipe in shop with specified cold-applied tape system with 50 percent overlap and in accordance with manufacturer's recommendations.
4. Spirally wrap pipe joints without bolting or slip rings in field with specified cold-applied tape system with 50 percent overlap. Cover exposed metal in joint with tape coating and overlap shop applied pipe coatings a minimum of two inches.
5. Coat pipe joints with bolting or slip rings in field with specified bituminous mastic coating system. Cover exposed metal in joint with mastic coating including bolting and slip rings, and overlap shop applied pipe coatings a minimum of two inches.
6. Apply wax-tape coating to the unwrapped surfaces of bolts, thermite weld areas, harnesses, bends, flanges and other irregular surfaces that cannot be covered with specified tape coating system. Apply wax tape in accordance with NACE RP0375 and manufacturer's instructions.
7. Apply mastic in accordance with manufacturer's recommendations using brush or airless spray techniques. Allow adequate drying time before backfilling.

C. Inspection and Testing of Coatings

1. Preparation of surfaces and application of coatings and related material - Subject to visual inspection by Contractor's QC Representative. Perform inspection and testing in presence of Contractor's QC Representative, unless Contractor's QC Representative has granted prior acceptance to perform such Work in its absence.
2. Surface preparation, cleanliness, application, and adhesion - Conform to coating manufacturer's specifications.
3. Employ a NACE-qualified coating inspector to inspect pipe coating for holidays, disbondment, and improper application. Conduct a high voltage electrical inspection of coating in accordance with NACE RP0274. Repair defects and re-inspect pipe coatings.
4. Conduct visual and high voltage electrical inspection of pipe coating in accordance with NACE RP0274 to locate holidays, disbandment, and improper application as soon after application of coating as practicable. Re-inspect replaced or repaired Work.
5. Conduct visual and high voltage electrical inspection of the pipe coating immediately before the coated pipe is placed in ditch to locate defects and damage to coating. Inspect fittings and other pipe appurtenances pre-coated before placement of pipe in ditch. Repair defective and damaged coatings and re-inspect before placement of pipe in ditch.
6. Conduct visual and high voltage electrical inspection of coatings applied after placement of pipe in ditch including tape coatings, wax-tape-coating systems, and mastic coatings for pipe joints, fittings, test wire connectors, and other pipe appurtenances, and heat shrink sleeves for insulating flanges. Repair defective and damaged coatings and reinspect before backfilling pipe.

7. Final acceptance of protective coatings - Based on electrical tests performed by Contractor's QC Representative after backfilling. Acceptance - Based on completed pipe system having a minimum, average coating resistance of 4000 ohm per square foot. Determine coating resistance using corrosion control test wires and other pipe access points, based on effective resistance to earth of pipe and pipe surface area. Pipe systems having a coating resistance less than 4000 ohm per square foot - Perform detailed coating fault survey and repair as necessary including excavation, recoating, and retesting.

D. Bonding of Buried Pressurized Pipe Systems

1. Bond across non-welded portions of piping, including mechanical joint connections, ball joints and expansion sleeves for flexible expansion joints, except in-line insulating devices. Make bond connections on flexible expansion joints at locations that do not interfere with movement and expansion of flexible joint. Provide sufficient slack in bond cables to allow for maximum expansion of flexible joint. Use two AWG No. 4 insulated bond cables for each joint unless otherwise indicated. Install bond cables to provide complete electrical continuity along entire length of each cathodically protected pipeline.
2. Welding Procedures - Make connections between copper conductors and metallic piping by thermite welding. Conform to procedures, materials and equipment specified in manufacturer's printed welding recommendations as reviewed and approved by Contractor's QC Representative.
3. Thermite Weld - Remove slag metal from weldment after weld has cooled. Test weld by striking with a two pound hammer while pulling on test/bond wire at a 45 degree angle. Remove and replace defective welds with new welds. Cover mastic-coated thermite weld connections with plastic shield cap.
4. Electrical continuity of bonded piping - Measured by Contractor's QC Representative after backfilling before final paving. Measured value compare to the theoretical value for piping being tested. Theoretical resistance - Based on length and diameter of pipe, number of pipe joint bonds, bond wire length and size, and per unit resistance values for components based on resistivity of pipe material and bond wires. Measured values exceeding theoretical values by more than 10 percent - Evaluated to determine possible remedial action. Locate and repair of defective or omitted pipe joint bonds, if required, including excavation and backfilling.

E. Insulating Devices - Provide insulating devices at connection to piping, between pipe sections of dissimilar metals, in each pressurized metallic service connection into structure or building just inside structure within five feet of point of entry, and where indicated. Install electrical isolation between each piping system and other metallic structures, including other metallic piping system in accordance with NACE RP0286.

1. Insulating Flanges - Store insulating flange kits in manner to protect from weather, water, dirt, and other foreign matter which could adversely affect electrical insulating properties.
 - a. After internal coating and connecting the insulating flange into one side of pipe system, measure electrical resistance across flange using an ohmmeter or other acceptable instrument. Perform test and have witnessed by Contractor's QC Representative. Resistance values less than one megohm - Require corrective action and retesting. Provide test results in tabular or other acceptable format.

- b. Install test facilities on each insulating flange unless otherwise noted.
 - c. Final acceptance of electrical effectiveness of insulating flange - By Contractor's QC Representative after installation. Replace defective components.
 - d. Coat exterior surfaces of buried insulating flanges with wax-tape sealer in accordance with manufacturer's recommendations. Before applying primer and wax-tape sealer, clean flanges and pipe surfaces for dirt, grease, water and other foreign materials. Apply primer and wax-tape sealer around bolts and flange-to-pipe transition so that sealer overlaps the pipe coating a minimum of two inches. Inspect coating as specified in Paragraph 3.07 C.
 - e. Coat exposed insulating flanges with cold applied mastic tape wrap. Thoroughly clean and dry insulating flange surface before coating is applied.
 - f. Show buried insulating flange test station locations on As-built Drawings, including reference to adjacent permanent landmarks or other suitable datum points.
2. PVC Inserts - Install PVC inserts, 18 inches in length, sized same as nominal pipe diameter, where indicated. Couple inserts into piping system without use of harnessing or tie rods that will bridge insert and result in a leakage path. Electrical tests are not required for PVC inserts. Do not use PVC inserts inside buildings.

F. Insulating Flange Coating

1. At each insulating flange, coat the interior of pipe with epoxy for a distance of two pipe diameters, minimum, in each direction from the flange.
 - a. Prepare mortar lining by brush- or sweep-abrasive blasting so that there is no evidence of laitance on the surface and cleaning soft or loosely-bound surfaces with a hard substrate.
 - b. Thoroughly mix the epoxy in accordance with manufacturer's printed recommendations.
 - c. Apply two coatings of undiluted epoxy, each coating a minimum of 10 mil thick. Apply second coating before first coating cures, within 12 hours, but not more than 24 hours based on atmosphere temperature of 75 deg F. However, when performing brush blasting of the first coating, the time interval between coats may be extended.
 - d. Measure thickness of each epoxy coat using a wet paint thickness gauge in accordance with ASTM D4414. Select no fewer than eight representative locations on each insulating flange. restore damaged coating after completion of measurements. Contractor's QC Representative will witness measurements.
 - e. After coating has set hard to touch, inspect with high-voltage holiday-detection equipment in accordance with NACE RPO274. Induce a holiday onto the coated surface to determine the minimum/maximum voltage. Set spark tester at 100 volts per one mil of film thickness. Adjust spark tester as necessary to detect the induced holiday. Mark each detected holiday and repair coating in accordance with manufacturer's recommendation, including additional surface preparation when required.

2. After installation is verified by Contractor's QC Representative, apply wax-tape system to exterior surfaces of each buried flange and irregular-shaped surface in accordance with manufacturer's printed recommendations and NACE RPO375.
 - a. Remove dirt, dust and loose rust with a wire brush; then, wipe with a clean cloth until dry. Apply primer by hand or brush, working a thin coating of primer into crevices, around bolts, in threads, and completely over exposed metal surfaces. Extend the primer coating a minimum of three inches onto adjacent pipe, fittings, or valves.
 - b. Apply wax tape immediately after applying primer. Cover each bolt head and nut using short lengths of tape. Work the tape into crevices around the bolts and nuts. Spiral wrap wax tape around the pipe and across flanges on to adjacent pipe, fittings, or valves. Overlap at least 55 percent of the tape width when applying the tape. Work the tape into crevices and contours of irregularly-shaped surfaces; then, smooth the tape so that there is a continuous protective layer that has no voids and no spaces under the tape.
 - c. Overwrap the completed wax-tape installation with the plastic wrapping material. Apply two layers of the clear plastic wrapping material by hand such that the material adheres and conforms to the surface of the wax tape. Spiral wrap with 55 percent, minimum, overlap of the wrapping material's width. Use adhesive tape to secure the wrapping material to the pipe.

G. Casing Sleeves

1. Install insulating type casing sleeves on metallic carrier pipes installed inside metallic casings unless otherwise indicated.
2. Install casing sleeve to withstand mechanical requirements of installation. If carrier pipe has non-rigid mechanical or push-on joints, install not less than two insulators per length of pipe. Annulus between outside diameter of carrier pipe and inside diameter of casing - Not less than two inches. For carrier pipe having joints which protrude from the outer wall of the pipe, annulus between inside diameter of casing and joints - Not less than one inch.
3. Size casing sleeves in accordance with manufacturer's requirements to allow continuous clearance between carrier pipe and protruding joints and inside surface of casing; allow carrier pipe to be removed from casing without disturbing casing on metallic carrier pipes. Metallic casings - Provide insulating type casing sleeves to maintain continuous electrical isolation between carrier pipe and the casing.

H. Casing End Seals - Seal ends of casing at carrier pipe with casing end seals.

1. Size and install end seals in accordance with manufacturer's instructions to obtain a watertight seal.
2. Install end seals to provide electrical isolation between metallic casing and metallic carrier pipe.

I. Insulating Wall Sleeves

1. Where pressurized buried metallic piping systems penetrate vault walls, at-grade floor slabs and other locations indicated without an exterior sealing membrane, install sleeves with insulating type modular seals electrically to isolate carrier pipe from metallic sleeves. Assemble links in seal loosely with bolts to form a continuous

- rubber belt around pipe with a pressure plate under each bolt head and nut. After seal assembly is positioned in metallic sleeve, tighten bolts so that rubber sealing elements expand and provide watertight seal between carrier pipe and sleeve.
2. Where pressurized buried metallic piping systems penetrate exterior below-grade walls, floors and ceilings with exterior sealing membrane, install sleeves with insulating type seals electrically to isolate carrier pipe from sleeve as follows.
 - a. Sleeves more than 15 feet below grade (Class C)
 - 1) Install a cast iron sleeve with compression seals.
 - 2) Install sleeve assembly and seals to provide complete electrical isolation between carrier pipe and metallic components of sleeve including membrane and pressure clamps.
 - b. Sleeves 15 feet or less below grade (Class D)
 - 1) Install a steel sleeve with modular link seals.
 - 2) Seal annular space between sleeve and pipe with insulating type modular link seals. Assemble links loosely with bolts to form a continuous rubber belt around pipe with a compression plate under each bolt head and nut. After seal assembly is positioned in sleeve, tighten bolts to expand sealing elements providing electrical isolation between pipe and sleeve, and a hydrostatic seal.
 - c. Provide sufficient radial clearance beyond pipe or pipe plus coating to accommodate installation of sealing elements.
 - d. Extend exterior coating on buried piping flush with exterior surface of sealing element at outer membrane clamp.
 - e. Caulking and Other types of sealants mastic or lead and oakum joints are unacceptable for exterior below-grade penetrations.
 - f. Verify by testing that sleeve penetrations are watertight before backfilling by testing in accordance with sleeve manufacturer's recommendations.
 3. Install insulating wall seals to provide electrical isolation between carrier pipe and metallic components of sleeve and seals. Caulking, other types of mastic sealant, and lead oakum joints are not acceptable.
- J. Electrical Isolation - Install underground and buried pressurized metallic piping systems electrically isolated and not in contact with other metallic piping or structures.
- K. Cathodic Protection System - Install cathodic protection systems for buried pressurized ductile iron and steel piping, and where indicated, as specified in Section 26 42 00, Cathodic Protection Systems.

3.08 FLEXIBLE PIPE CONNECTIONS

- A. Align and space piping accurately before installation. Do not use flexible connections to correct misalignment.
- B. Support piping near equipment to prevent weight of pipe from compressing or extending flexible connection from required installed setting.

- C. Install as recommended by manufacturer.

3.09 GAUGES

- A. Provide gauges and gauge connections where indicated on the plumbing drawings.
- B. Install gauge siphon at surge protection where service pulsates or surges.

3.10 ACCESS PANELS

- A. Required Locations Wherever plumbing valves and similar items requiring servicing and adjustment are concealed. Panels are not required in furred surfaces with removable panels.
- B. Types
 1. In fire rated ceilings - Fire rated access panel, fill-in type or flat-faced panel as required.
 2. Other locations - Flat-faced panel.

3.11 PIPE AND VALVE IDENTIFICATION

- A. As specified in Section 22 05 53, Plumbing System Identification.

3.12 EQUIPMENT INSTALLATION

- A. Place plumbing equipment in locations and spaces indicated. Move plumbing equipment into spaces through openings as required.
- B. Provide hangers and supports required for installation of plumbing equipment. Furnish plumbing equipment support information for construction of concrete housekeeping pads provided by Section 03 30 00, Cast-in-Place Concrete.
- C. Mount plumbing equipment on concrete housekeeping pads as required, in accordance with reviewed and accepted Shop Drawings and Contract Drawings.
- D. Install, align and adjust fixtures, plumbing equipment, vibration isolators and the like in accordance with manufacturer's instruction and recommendations. Resolve differences between manufacturer's instructions and these Contract Documents with Contractor's QC Representative before proceeding with the installation.
- E. Install equipment furnished as specified above.
- F. Install plumbing equipment where indicated in accordance with manufacturer's instructions.

3.13 SEISMIC RESTRAINTS

- A. Install seismic restraints in accordance with Standard cited under Paragraph 2.19 in this Section, and manufacturer's instructions. Coordinate installation of seismic restraints with interfacing and adjacent equipment and materials specified in this Contract and by other Contractors, subcontractors, trades, and crafts, including furnished equipment.
- B. Document installation as specified in Project Quality Control / Quality Assurance Plan (QCQAP)

3.14 TOTALIZER SYSTEM

- A. Install totalizer meter and flow sensor in accordance with manufacturer's instructions. Install flow sensor after system flushing is completed. If possible, install sensor in horizontal position. Where non-horizontal sensor installation is required, install sensor at 45 degrees above horizontal. Install wire and wireways interconnecting meter, and flow sensor. Checkout and test in accordance with manufacturer's instructions. Submit test reports verifying flow indication and metering functions, and protection from electromagnetic and radio frequency interferences.

3.15 CASINGS FOR BURIED PIPING

- A. Coat pressurized ductile iron and steel carrier pipe as specified under Protective Coating for Underground Piping.
- B. Install casing sleeves as specified under Casing Sleeves.
- C. Install casing end seals as specified under Casing End Seals.

3.16 THRUST BLOCK

- A. Coat ductile iron and steel pipe and fittings at thrust blocks as specified and cover with a loosely applied felt wrap secured to the pipe with pressure sensitive tape.
- B. Protect Steel Tie - Rods and clamps by a heavy coating of bituminous mastic as specified.
- C. Listed retaining mechanical joint glands and retaining tyton style gaskets may be used In lieu of thrust blocks on buried fire water supply piping.

END OF SECTION

SECTION 22 05 29

PLUMBING PIPE SLEEVES, SUPPORTS, GUIDES AND ANCHORAGES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing and installing pipe sleeves, pipe supports, pipe hangers, pipe guides and anchorage devices for plumbing piping systems as indicated, including guidelines for selection and sizing items and preparation of fully dimensioned Shop Drawings showing locations.

1.02 RELATED SECTIONS

- A. Section 07 62 00: Sheet Metal Flashing & Trim
- B. Section 07 84 00: Fire Stopping
- C. Section 07 92 00: Joint Sealants
- D. Section 22 05 00: Basic Plumbing Requirements

1.03 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - ASME B31.1 Power Piping
 - ASME B36.10M Welded and Seamless Wrought Steel Pipe
- B. ASTM International (ASTM)
 - ASTM A36/A36M Standard Specification for Carbon Structural Steel
 - ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - ASTM A74 Standard Specification for Cast iron Soil Pipe and Fittings
- C. Federal Specifications (FS)
 - FS FF-S-325 Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
 - FS WW-H-171 Hangers and Supports, Pipe
- D. Underwriters Laboratories Inc. (UL)
 - UL 1479 Fire Tests of Through-Penetration Fire-stops

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).
- B. Perform installation and testing of work as specified, in accordance with instructions provided by equipment suppliers. Perform testing under observation and approval of Contractor's QC Representative. Notify Contractor's QC Representative at least three days in advance of tests.
- C. Criteria for Selection of Pipe Sleeves:
 - 1. Sleeves through interior walls, floors and ceilings - Shall be galvanized steel pipe sleeves.
 - 2. Sleeves through exterior below-grade walls, floors and ceilings with an exterior sealing membrane Shall be:
 - a. Cast iron sleeves with compression seals for sleeves more than 15 feet below grade.
 - b. Steel sleeve with modular link seals for sleeves 15 feet or less below grade.
 - 3. Sleeves through exterior below-grade walls, floors and ceilings without any exterior sealing membrane - shall be steel sleeve with modular link seals.
 - 4. Sleeves through exterior above-grade roofs - shall be one of the following:
 - a. Lead flashing sleeve or copper sleeve with skirt.
 - b. Cast iron sleeve with flashing clamp device, pressure ring and accessories.
- D. Criteria for Pipe Supports, Hangers, Guides and Anchors:
 - 1. Provide pipe hangers and supports suitable for indicated usage in accordance with FS WW-H-171.
 - 2. Provide pipe hangers of same size or nearest manufactured size available, as pipe or tubing on which used except for insulated piping.
 - 3. Hangers and supports - Support weight of pipe, fluid and pipe insulation, with a minimum factor of safety of five based on ultimate tensile strength of supports and hangers material.
 - 4. Install pipe guides to prevent horizontal and vertical displacement of piping.
 - 5. Anchor and support piping as indicated and as specified, including seismic restraint.
 - 6. Provide concrete inserts for attachments to sump walls and sump floors. Do not use drilled anchors in these locations.
- E. Criteria for Location of Pipe Supports and Hangers:
 - 1. Vertical spacing - Guide and support vertical piping in center of each riser, but not over 15 feet on centers for ferrous piping and not over 10 feet on centers for copper piping, unless otherwise indicated. Also guide and support at the base of pipe riser on a base elbow, or tee with pipe stand, or as required. Provide riser clamp in accordance with FS WVV-H-171, Type 8, with required spacing at each landing in stairwells. For un-insulated copper pipe or tubing, use nonferrous or copper plated or electrolytically coated steel compatible hangers for the riser clamp.

2. Horizontal spacing
 - a. Provide maximum hanger and support spacing, on centers, for horizontal piping as follows, unless indicated otherwise:

TYPE OF PIPE	3/4" SIZE OR SMALLER	1" THROUGH 1-1/2" SIZE	1-1/2" SIZE OR LARGER
Steel Pipe	8'-0"	10'-0"	10'-0"
Copper Tubing	5'-0"	8'-0"	10'-0"
Cast Iron Pipe in 5'-0" Lengths			5'-0"
Cast Iron Pipe in 10'-0" Lengths			10'-0"

- b. Place a hanger close to point of change of direction of a pipe in a horizontal or vertical plane.
 3. Place supports and hangers for each cast iron soil pipe as close as possible to joints. Where hangers or supports do not come within one foot of a branch line fitting, install an additional hanger or support at fitting.
- F. Allowable Deviation from Accepted Location - Locate pipe sleeves and pipe support and anchorage devices not more than 1/2 inch from locations indicated on reviewed and accepted Shop Drawings.
- G. Perform welding operations in accordance with requirements specified in Section 05 05 33, Basic Welding Requirements.

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal Requirements. Submit the following:
- B. Provide Shop Drawings showing exact locations of pipe sleeves and pipe support and anchorage devices.
- C. Provide Shop Drawings or manufacturer's data of pipe sleeves and pipe support and anchorage devices. Show detailed dimensions and description of materials and parts on drawings or cuts.
- D. Provide Manufacturer's product data.
- E. Provide Welder certifications and qualified welding procedures for review and acceptance and records to Contractor's QC Representative.
- F. Provide Certification and necessary documentation as required in Section 05 05 33, Basic Welding Requirements.

1.06 DEFINITIONS (NOT USED)

1.07 WORKSITE CONDITIONS

- A. Do not drill, cut, burn or weld structural members in connection with installation of pipe supports, bracing and anchorage devices, unless approved by a structural engineer licensed by State of California and reviewed and approved by Contractor's QC Representative.

PART 2 - PRODUCTS

2.01 PIPE SLEEVES

- A. Refer to Section 07 84 00, Firestopping, for firestop materials and installation; Section 07 62 00, Sheet Metal Flashing and Trim, for flashing materials and installation; and Section 07 92 00, Joint Sealants, for sealing and packing materials and installation, except as otherwise indicated.
- B. Sleeves Through Interior Walls, Floors and Ceilings
 - 1. Sleeves - Provide galvanized steel pipe conforming to ASTM A53/A53M.
 - 2. Packing - Where pipes pass through fire-rated walls, floors or ceilings provide firestop material to seal opening between pipe and sleeve. For other penetrations, provide sealing material.
 - 3. Escutcheons - As specified for piping system penetrating sleeve.
- C. Sleeves through Exterior Below-Grade Walls, Floors and Ceilings with an exterior sealing membrane.
 - 1. Sleeves more than 15 feet below grade - Shall be cast iron, ASTM A74 pressure sealing with membrane clamp; cast iron body with external fins, internal steel compression rings and nitrile rubber grommets, and pressure clamp with 18-8 stainless steel bolts; nonconductive pipe sleeve between cast iron body sections; oversize steel sleeve with neoprene sealing rings and coating as indicated. Sealing members - Provide electrical isolation between carrier pipe and metallic components of sleeve including membrane and pressure clamps.
 - 2. Sleeves 15 feet or less below grade - Steel pipe sleeve, ASTM A53/A53M, pressure sealing with membrane clamp ring, gasket, Water-stop ring, external rings, internal dielectric compression plates, nitrile rubber link seals and coating on metal parts as indicated.
 - a. Seals - Modular mechanical type seals, consisting of interlocking nitrile rubber links shaped to continuously fill annular space between pipe and sleeve and electrically isolate carrier pipe from the steel sleeve.
 - b. Sealing element - Nitrile rubber material compounded to resist aging, ozone, sunlight, hydrocarbon gases, water and chemical action.
 - c. Hardware - Type 18-8 stainless steel fasteners. Threads rolled to produce smooth uniform threads and unbroken flow lines.

- d. Compression plates-properties, dielectric strength and non-cold flow creep characteristics, with high resistance to acidic and alkaline soils.
- D. Sleeves through Exterior Above-Grade Walls, Floors and Ceilings without an exterior sealing membrane.
 - 1. Sleeves – Shall be steel pipe sleeves, ASTM A53/A53M.
 - 2. Seals – Shall be modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between carrier pipe and metallic sleeve and electrically isolate carrier pipe from sleeve and glass reinforced nylon pressure plates.
- E. Sleeves Through Exterior Above-grade Roofs - Provide one of following:
 - 1. Lead flashing sleeve weighing 4 psf, or copper sleeve weighing 16 ounces per square foot, suitably framed with skirt extending not less than eight inches.
 - 2. Cast iron sleeve with caulking recess, anchor lugs, flashing clamp device and pressure ring with brass bolts.

2.02 PIPE HANGERS, SUPPORTS AND GUIDES

- A. Provide pipe hangers, pipe supports and pipe guides as indicated, hot-dip galvanized or electro-galvanized unless otherwise indicated. Provide copper-plated hangers for un-insulated copper pipes.
- B. Anchors for Pipe Hangers and Supports:
 - 1. Metal inserts cast into concrete at time of placing concrete.
 - 2. Anchor bolts placed in drilled holes and set in place with high strength cement/epoxy grout.
 - 3. Expansion bolts, FS FF-S-325, set in drilled holes. Follow manufacturer's instructions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install pipe sleeves, pipe supports, guides and anchorage devices where indicated on reviewed and accepted plumbing Shop Drawings.
- B. Rigidly secure pipe sleeves, pipe supports, guides and anchorage devices against displacement by concrete placement operations.

3.02 INSTALLATION OF PIPE SLEEVES

- A. General Requirements
 - 1. Provide pipe sleeves where plumbing pipes pass through exterior wall and interior wall, floor, ceiling and roof, and at other locations indicated.

2. Set pipe sleeves parallel to pipes that pass-through sleeves.
 3. Do not install sleeves in structural members except where indicated or approved.
 4. Secure sleeves to concrete forms to prevent displacement during placement of concrete.
- B. Sleeves through Interior Walls, Floors and Ceilings
1. Install permanent sleeves of steel pipe as indicated.
 2. Where sleeves cannot be installed, such as at connections to floor drains. Do not allow pipes to be in contact with reinforcing steel.
 3. Cut pipe sleeves through walls flush with finished wall surfaces. Sleeves through interior floors shall project minimum two inches above finished floor, and flush with finished ceiling surface.
 4. Provide minimum nominal 1/2 inch annular clearance beyond pipe and pipe plus insulation or coating to accommodate installation of packing.
 5. Where pipes pass through fire-rated walls, floors or ceilings, install fire-rated packing in opening between pipe and pipe sleeve.
 6. Where pipes pass through non-fire-rated walls, floors or ceilings, seal opening between pipe and pipe sleeve, and make watertight.
- C. Sleeves through Exterior Below-Grade Walls, Floors and Ceilings with an exterior sealing membrane
1. Sleeves more than 15 feet below grade
 - a. Install a cast iron sleeve with compression seals as indicated.
 - b. Install sleeve assembly and seals to provide complete electrical isolation between carrier pipe and metallic components of sleeve including membrane and pressure clamps.
 2. Sleeves 15 feet or less below grade
 - a. Install a steel sleeve with steel plate anchor or water-stop, and with modular link seals as indicated.
 - b. Seal annular space between sleeve and pipe with insulating type modular link seals. Assemble links loosely with bolts to form a continuous rubber belt around pipe with a compression plate under each bolt head and nut. After seal assembly is positioned in sleeve, tighten bolts to expand sealing elements providing electrical isolation between pipe and sleeve, and a hydrostatic seal.
 3. Provide sufficient radial clearance beyond pipe or pipe plus coating to accommodate installation of sealing elements.
 4. Extend exterior coating on buried piping flush with exterior surface of sealing element at outer membrane clamp.
 5. Other types of sealants and joints are unacceptable for exterior below-grade penetrations.
 6. Verify that sleeve penetrations are watertight before backfilling by testing in accordance with seal manufacturer's recommendations.

- D. Sleeves through Exterior Below-Grade Walls, Floors and Ceilings without an exterior sealing membrane- Install a steel sleeve with electrical isolation type modular link seals and glass reinforced nylon pressure plates in accordance with Section 22 05 00, Basic Plumbing Requirements, Article 2.15..
- E. Sleeves Through Exterior Above-Grade Roofs - Install flashing and cast iron sleeves as indicated on reviewed and accepted Shop Drawings and in accordance with manufacturer's instructions.

3.03 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- A. Provide above-ground plumbing piping systems inside and outside buildings with anchorages, sway braces, guides and supports as required by applicable portions of the California Plumbing Codes, as applicable, except as otherwise indicated. Install seismic restraints.
 - 1. Provide pipe supports as indicated. Necessary hangers and supports, including beam and purlin clamps, rods, pipe rolls, angles, channels and plates, as well as changes from indicated design – Shall be reviewed and approved by Contractor's QC Representative before installation.
 - 2. Use of building structural steel for supporting hangers shall not be permitted unless indicated or reviewed and approved by Contractor's QC Representative .
 - 3. Support vertical piping with approved steel brackets to prevent swaying, sagging, vibration and resonance; allow for thermal expansion between supports and anchors. Do not use flat steel strap hangers.
 - 4. Do not support piping by wire, rope, strap, chain, wood or similar devices.
 - 5. Provide hose faucets, compressed air outlets and similar items with short cantilevers at ends of pipe branches.
 - 6. Supporting structures, including supporting frames, anchors and guides common to mechanical Work and electrical Work.
 - 7. When piping to equipment mounted on vibration isolators, provide spring cushion or other reviewed and accepted type isolation hanger on pipe support nearest, and at each side of the equipment.
 - 8. Except as otherwise noted, use adjustable iron hangers for 1 1/4 inch and smaller pipe, and clevis type for 1 1/2 inch and larger pipe. Where copper tubing is directly supported, use copper plated hangers.
- B. Supports for Insulated Piping
 - 1. For insulated domestic cold water lines larger than two inches, use pipe saddles as required for supporting piping from exterior of insulation. At time of installation, fill with insulating cement.
 - 2. Instead of saddles, pipe two inches and smaller may be supported from insulation with galvanized steel half round protective shields.
 - 3. For vertical piping four inches and larger, provide angle or plate type insulation supports welded to pipe at approximately 12 foot intervals. Fabricate supports of

same material as pipe to which attached, and of widths less than thickness of insulation covering.

4. Install hangers around insulation of insulated domestic hot water lines. For insulated domestic hot water lines larger than two inches, insert section of 10-inch long by 180-degree cellular glass, minimum eight pcf density, with vapor barrier jacket plus 18 gauge by 10-inch by 180-degree galvanized steel shield. Special hangers equipped with equivalent Insulating material and vapor barrier may be used. For insulated domestic hot water lines two inches and smaller, support may be same as that for insulated domestic cold water lines two inches and smaller.
- C. Supports for Embedded Piping - Provide supports for piping to be embedded in concrete as indicated on reviewed and accepted Shop Drawings. Support piping to be embedded at a maximum spacing of 15 feet between supports, unless otherwise reviewed and approved by Contractor's QC Representative.

3.04 INSTALL SEISMIC RESTRAINTS

- A. Install seismic restraints for piping and equipment as required and as specified in Section 22 05 00, Basic Plumbing Requirements.

3.05 WELD INSPECTION AND TESTING

- A. Visual Inspection: 100 percent welds per ANSI B31.1.
- B. Magnetic Particle Inspection: 10 percent welds per ANSI B31.1.
- C. If failure occurs in first 10 percent sample select second 10 percent sample, and test.
- D. If no failure occurs in second 10 percent sample, represented welds shall be acceptable (re-work failed sample in initial 10 percent sample). If failure occurs in second 10 percent sample, test 100 percent of welds.

END OF SECTION

SECTION 22 05 53

PLUMBING SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing and installing identification for plumbing equipment, piping, controls and valves.

1.02 RELATED SECTIONS (NOT USED)

1.03 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
ASME A13.1 Scheme for the Identification of Piping Systems

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal requirements and procedures.
- B. Provide manufacturer's data showing and describing pipe markers, valve markers and nameplates, equipment nameplates, and control nameplates.
- C. Provide valve list showing valve identification numbers, location including room number of each valve and function of each valve.
- D. Provide manufacturer's product data.
- E. Provide schematic piping diagrams for piping systems.
- F. Provide equipment cards and methods of attachment.
- G. Provide station map

1.06 DEFINITIONS (NOT USED)

PART 2 - PRODUCTS

2.01 SCHEMATIC PIPING DIAGRAMS AND STATION MAPS

- A. Provide schematic diagrams for piping systems indicating piping, valves and fixtures. Place diagrams, in a frame, in respective valve or equipment rooms, along with valve lists.
- B. Provide color-coded station map to scale. Show location of control valves.

2.02 PIPE MARKERS

- A. Provide pressure sensitive vinyl pipe markers, color coded for piping system and size coordinated with pipe size. Provide pipe markers of semi-rigid plastic, accessible for maintenance operations, except piping in finished spaces. Include direction-of-flow arrows and hazard identification. Directional arrows are to be separate from legend, pressure sensitive, and four inches wide nominal.
- B. Color code marker background with clearly printed legend to identify contents of pipe. Colors and legend shall be in accordance with ASME A13.1
- C. Identify potable water lines to distinguish from non-potable lines. Begin markings or identification on non-potable water lines immediately downstream of backflow preventers.

2.03 VALVE MARKERS

- A. Marker: shall be not lighter than 19 gauge polished brass. Also, not less than 1-1/2 inches in diameter. Marker shall bear valve identification number.
- B. Marker letters shall be 1/4 inch high. Marker numbers shall be 1/2 inch high. Marker letters and numbers shall be stamped and black-filled.
- C. Marker Fasteners shall be Meter seals, four-ply 18 gauge smooth copper wire, brass "S" hooks, or brass jack chain. Markers shall bear identifications as indicated.

2.04 EQUIPMENT NAMEPLATES

- A. Label mechanical equipment, including valves. Mechanical equipment label shall be aluminum, with black enamel background and etched or engraved lettering. Height of Lettering shall be minimum 1/2 inch. Nameplates shall bear notations corresponding to same notations on equipment schedules, control diagrams, framed wiring diagrams, and operating instructions. Provide unique identification for valves and other equipment that is not on an equipment schedule.

2.05 CONTROL NAMEPLATES

- A. Label control devices, including totalizer system components, flow switches, valve supervisory switches and pressure switches. The label shall be laminated colored plastic with white lettering. For labeling switches clearly indicate and identify switch positions. For nameplates identify respective item and function with unique alpha-numeric label.

2.06 SCHEMATIC PIPING DIAGRAMS AND VALVE LIST FRAME

- A. Provide aluminum picture frame with clear fire-retardant plastic front.

2.07 VALVE LIST

- A. Shall be typed or printed on framed heavy white bond paper. Provide lists for each system delineating each valve. Include name of system, unique identifier, valve type, description (model, size manufacturer, characteristics, feature, and the like), usual position, function and reference to operation and maintenance manual.
- B. Valve list closure shall be transparent fire-retardant plastic. Front and back plastic sheets which form closure shall not be thinner than 15 mils. Punch two holes at top of plastic closure to allow a nickel-plated bead chain to be affixed thereto.

2.08 ORIFICE PLATE TAG

- A. For orifice meters, provide brass tag secured with not less than 18 gauge copper wired to pipe extension. Identify make, model and serial number of portable meter connected to device.

PART 3 - EXECUTION

3.01 INSTALL PIPE MARKER

- A. Install pipe markers in transparent fire retardant plastic punch, adjacent to each valve and fitting, except on plumbing fixtures and equipment; at each branch and riser take-off; at each pipe passage through wall, floor and ceiling construction; at each pipe passage to underground, and on 25 foot centers on horizontal pipe runs in corridors and other large spaces.
- B. Apply markers in strict accordance with manufacturer's instructions and recommendations. Use directional arrow tape on each end of marker to ensure added adhesion. Apply directional arrow tape completely around the pipe as recommended by the manufacturer but not less than 1-1/2 times around the pipe.

3.02 VALVE MARKERS

- A. Markers shall be fastened to or hanged from valve body to be easily readable.

3.03 SCHEMATIC PIPING DIAGRAMS AND VALVE LISTS

- A. Place one framed diagram and valve list into each respective equipment room at each level of the station or tunnel structure. Place a framed fire protection schematic diagram along with valve list in each equipment room or similar room having more than two valves.

3.04 EQUIPMENT NAMEPLATES

- A. Mount nameplates with corrosion resistant fasteners at a visible location without dismantling equipment or adjacent items.

3.05 CONTROL NAMEPLATES

- A. Mount control nameplates with corrosion resistant fasteners.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing and installing thermal insulation for plumbing systems as indicated.

1.02 RELATED SECTIONS

- A. Section 07 84 00: Fire Stopping
- B. Section 07 92 00: Joint Sealants
- C. Section 09 91 00: Painting and Coating

1.03 REFERENCES

- A. ASTM International (ASTM)
 - ASTM A525 General Requirements for Steel Sheet, Zinc-coated (Galvanized) by the Hot-Dip Process.
 - ASTM C195 Mineral Fiber Thermal Insulating Cement
 - ASTM C552 Cellular Glass Thermal Insulation
 - ASTM C1136 Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - ASTM D828 Tensile Breaking Strength of Paper and Paperboard
 - ASTM E84 Surface Burning Characteristics of Building Materials
 - ASTM E96 Water Vapor Transmission of Materials
- B. Federal Specifications (FS)
 - FS HH-I-558 Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering Thermal (Mineral Fiber, Industrial Type) Hangers and Supports, Pipe; Coal-Tar Base Coating
- C. Department of Defense, Military Specifications (MIL)
 - MIL-A-3316C Adhesive, Fire-Resistant, Thermal Insulation
 - MIL-C-18480 Coating Compounds, Bituminous, Solvent, Coal-Tar Base.

MIL-C-19565	Coating Compounds, Thermal Insulation, Fire and Water Resistant, Vapor Barrier
MIL-C-20079	Cloth, Glass, Tape, Textile Glass, and Thread, Glass
MIL-I-47049	Insulation Tubing, Silicone Rubber, Heat Shrinkable

- D. National Fire Protection Association (NFPA)
 - NFPA 255 Test of Surface Burning Characteristics of Building Materials
- E. International Conference of Building Officials (ICBO)
 - CBC California Building Code
- F. Underwriters Laboratories Inc. (UL)
 - UL 723 Test for Surface Burning Characteristics of Building Materials

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).
- B. Provide UL label or listing, or satisfactory certified test report from an accepted testing laboratory indicating that fire hazard ratings for products proposed for use do not exceed specified ratings. Conform to CBC.
- C. Products or Shipping Cartons – Shall bear label indicating fire and smoke hazard ratings of the material as specified.
- D. Provide Fire Resistance Values as Follows: Insulation, adhesives, jackets, vapor-barrier materials and other accessories – Shall be noncombustible as defined in CBC with flame-spread rating not more than 25 and smoke developed rating not more than 50. Determine flame spread and smoke developed ratings by Test of Surface Burning Characteristics of Building Materials, NFPA 255, ASTM E84, or UL 723. Provide materials listed in UL Building Material List under heading Hazard Classification (Fire), or tested by accepted testing laboratory in accordance with UL criteria.

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal requirements and procedures.
- B. Manufacturer's product data.
- C. Installation details for mechanically fastened products.

1.06 DEFINITIONS (NOT USED)

1.07 WORKSITE CONDITIONS

- A. Provide surfaces acceptable for installation of products.

PART 2 - PRODUCTS

2.01 PIPING INSULATION

- A. Provide piping insulation in accordance with Table 1. Insulate fittings, flanges and valves, except valve stems, hand wheels and operators, with pre-molded, pre-cut or job fabricated insulation of equivalent thickness and of same composition as insulation installed on adjacent piping. Provide vapor barrier jackets, factory applied, on pipe insulation except on hot water lines insulation.

TABLE 1 – INSULATION MATERIAL FOR PIPING

SERVICE	MATERIALS	IDENTIFICATION	TYPE	GRADE	CLASS	THICKNESS
Domestic Hot Water	Mineral Fiber	FS HH-I-558	D	III	12	One Inch
Domestic Cold Water/ Condensate Drain When Above Ceiling	Mineral Fiber	FS HH-I-558	D	III	12	One Inch

2.02 INSULATION FINISHES

- A. Provide vapor barrier jackets for piping, and equipment insulation conforming to FS HH-B-100, Type I or II for piping and equipment.
- B. Pre-sized Glass Cloth Jacket - With or without integral vapor barrier. Type with integral vapor barrier may be used instead of specified vapor barrier and with a perm rating as specified in FS HH-B-100, Type I or II for vapor barrier jacket for applicable service. Provide glass cloth jackets with bursting strength not less than 200 psi in accordance with ASTM D774, and shall not support fungus growth. Provide factory applied jackets on insulation.
- C. Provide all-purpose jacket having a perm rating not more than 0.02 in accordance with ASTM E96, and tensile strength not less than 35 pounds/inch width in accordance with ASTM D828. Factory apply all-purpose jacket on pipe and water heating equipment which does not have factory insulation. Provide glass-scrim-reinforced white vinyl finish.

2.03 ADHESIVE COATINGS AND SEALING COMPOUNDS

- A. Provide adhesive coatings and sealing compounds compatible with materials to which applied, and not corrode, soften or otherwise attack such material in wet or dry state.
- B. Lap Adhesive for Vapor Barrier Jackets - Conform to MIL-A-3316C, Class 2.
- C. Lagging Adhesive - Conform to MIL-A-3316C, Class 1.
- D. Insulation Cement - Conform to ASTM C195.

- E. Bonding adhesive for securing insulation to metal surfaces – Shall be as recommended by insulation manufacturer.
- F. Coating Compounds
 1. Coating compound used as vapor barrier treatment – Shall conform to MIL-C-19565, Type I or II. Provide white vapor barrier coating where exposed to view.
 2. Coating compound used as metal protection – Shall be in accordance with FS SS-C-540; coal tar base coating, and shall conform to MIL-C-18480.
 3. Weatherproofing coating compound for protective finish outdoors – Shall conform to MIL-C-19565, Type I.
 4. Glass tape – Shall conform to MIL-C-20079, Type II, Class I.
 5. Coating compound used as vapor barrier for fittings on piping systems above 35°F – Shall be polyvinyl chloride.

2.04 PROTECTION SHIELDS

- A. Conform to FS WW-H-171, Type 41.

2.05 FASTENERS

- A. Provide fasteners of corrosion resistant material. Provide staples of minimum 3/4 inch width; thickness not less than 0.005 inch for zinc-coated steel and not less than 0.007 inch for aluminum.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. Insulate piping systems as listed in Part 2, Table 1. Insulate fittings, flanges, and valves unless otherwise specified.

3.02 PIPE INSULATION

- A. Sectional pipe insulation - Place sections of insulation around pipe and tightly butt into place. Draw jacket laps tight and smooth, and secure with fire-resistant adhesive and non-corrosive outward-clinching staples spaced not more than four inches on centers and one inch from edge of lap.
- B. Cover circumferential joints with butt strips not less than three inches wide, of material identical to jacket material. Secure butt strip with same adhesive used to secure jacket laps. Apply staples to both edges of butt strips. Seal staples and seams with a brush coat of fire-resistant coating applied at longitudinal and circumferential laps. Staples may be omitted when factory-applied, self-sealing system is used unless fish mouths develop.
- C. Coat ends of sections of insulation that butt against flanges, unions, valves, fittings and joints at intervals of not more than 12 feet on continuous runs of pipe with a vapor barrier

coating. Patch breaks and punctures in jacket material by wrapping a strip of jacket material around pipe and cementing, stapling and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past break in both directions. Fill voids at penetrations of insulation, such as thermometers, with vapor barrier coating, and seal penetration with a brush coat of same coating.

- D. Provide continuous insulation through pipe hangers. At hangers where pipe is supported, provide an insulated protection shield.
- E. Test factory applied materials as assembled. Test field applied materials individually. Do not employ fungicide or corrosive treatment to impart flame resistance. Flame-proofing treatments subject to deterioration due to effect of moisture or high humidity are not acceptable. Test, clean and inspect surfaces and equipment to which insulation will be installed before the Work of this Section begins.

END OF SECTION

SECTION 22 11 00

WATER SUPPLY SYSTEM (PLUMBING)

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing, installing and testing domestic water supply system in station. Connect water supply system to water main. Protect potable water systems from contamination by providing back flow protection between site water distribution and water service supply main as approved by regulatory agencies having jurisdiction. Also, reference Section 33 00 00, Piped Utilities.

1.02 RELATED SECTIONS

- A. Section 09 91 00: Painting and Coating
- B. Section 22 05 00: Basic Plumbing Requirements
- C. Section 22 05 29: Pipe Sleeves, Supports, Guides and Anchorage
- D. Section 22 05 53: Plumbing Systems Identification
- E. Section 31 20 00: Earthwork
- F. Section 33 00 00: Piped Utilities

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
ANSI Z21.22 Relief Valves and Automatic Gas Shutoff Devices for Hot water Supply Systems
- B. American Society of Sanitary Engineering (ASSE)
ANSI/ASSE Water Pressure Reducing Valves for Domestic Water Supply Systems
- C. ASTM International (ASTM)
ASTM B543 Welded Copper and Copper-Alloy Heat Exchanger Tube
ASTM B813 Flux, Soldering; Paste Fluxes for Soldering Copper and Copper Alloys ASTM B32-08 Solder Metals
- D. American Water Works Association (AWWA)
AWWA C651 Disinfecting Water Mains

- E. Federal Specifications (FS)
 - FS O-F-506 Flux, Soldering; Paste and Liquid
 - FS WW-N-351 Nipple, Pipe, Threaded
 - FS WW-U-516 Unions, Brass or Bronze, Threaded Pipe Connections and Solder Joint Tube Connections
- F. Manufacturers Standardization Society (MSS)
 - MSS SP-80 Bronze Gate, Globe, Angle and Check Valves
- G. Plumbing and Drainage Institute (PDI)
 - PDI WH 201 Water Hammer Arrestors
- H. California Plumbing Code (CPC), 2019.

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).
- B. Conform to AWWA and local codes for installing, testing and disinfecting water supply systems.

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal requirements and procedures.
- B. Shop Drawings for material and equipment showing pipe and piping layout, valves, and locations of valves, shock absorbers, escutcheon plates, and seismic restraint details and locations.
- C. Working Drawings, hydraulic calculations and test certificates.
- D. Operation and maintenance data for equipment furnished, as specified in Section 11.3 of the General Requirements.
- E. Schematic piping diagram with respective valve list, as specified in Section 22 05 53, Plumbing Systems Identification.
- F. Procedures before testing and disinfecting, and test report.
- G. Manufacturer's Product Data - Include catalog cuts and specifications for corrosion control materials as specified in Section 22 05 00, Basic Plumbing Requirements.
- H. As Built-Drawings - Maintain up-to-date, legible, accurate, dimensioned reproducible record of as-built location of all work installed under this Contract for review and approval.

1.06 DEFINITIONS (NOT USED)

1.07 WORKSITE CONDITIONS

- A. Prevent damage to protective pipe coatings during storage and delivery as specified in Section 22 05 00, Basic Plumbing Requirements, Article 1.06.
- B. Apply exterior pipe coatings only during favorable conditions of temperature and humidity as specified in Section 22 05 00, Basic Plumbing Requirements.

1.08 COORDINATION

- A. Coordinate installation of water supply system with other building systems and components; avoid conflicts of installation. Drawings are diagrammatic only. Do not scale drawings for exact location of installation.

PART 2 - PRODUCTS

2.01 BURIED PIPE AND FITTINGS

- A. Provide type, size and configuration indicated.
- B. Ductile Iron Pipe and Fittings - Class J with exterior protective coating, for pipes three inches and larger in diameter, as specified in Section 22 05 00, Basic Plumbing Requirements.
- C. Copper Tubing and Fittings - Class E, for pipes less than three inches in diameter, as specified in Section 22 05 00, Basic Plumbing Requirements.
- D. Provide protective coatings for pressurized buried and embedded pipe and fittings, as specified in Section 22 05 00, Basic Plumbing Requirements.
- E. Provide insulating connections, pipe joint bonds and corrosion control test facilities for pressurized buried pipe as specified in Section 22 05 00, Basic Plumbing Requirements.
- F. Provide watertight wall sleeves where pressurized buried metallic piping systems penetrate exterior below-grade walls, floors, and ceilings as specified in Section 22 05 00, Basic Plumbing Requirements.
- G. Casings For Buried Pipe – Provide steel casings, nonmetallic casings, and casing sleeves and casing end seals for carrier pipes as specified in Section 22 05 00, Basic Plumbing Requirements.
- H. Provide protective coatings for buried insulating flanges and flexible expansion joints.
- I. Provide flexible expansion joints for buried water supply lines, including exterior coatings, as specified in Section 22 05 00, Basic Plumbing Requirements.

2.02 ABOVEGROUND AND EMBEDDED PIPE AND FITTINGS

- A. Provide specified type, size and configuration.
- B. Heavy Type Copper Alloy Tube - ASTM B543, Alloy 194.
- C. Copper Tubing and Fittings – Class E as specified in Section 22 05 00, Basic Plumbing Requirements.

2.03 JOINTS AND JOINTING MATERIALS

- A. Flanges for Ends of Pipe and Fittings - Provide cast iron conforming to AWWA C110, except use screwed-on type flanges for pipe, with threads conforming to ANSI B16.1 for 125 pound class. Provide bolts, nuts and gaskets as specified in Section 22 05 00, Basic Plumbing Requirements. Gaskets: 1/8 inch thick neoprene.
- B. Provide dielectric insulating devices as specified in Section 22 05 00, Basic Plumbing Requirements, for metallic water line connections and where required.

2.04 VALVES

- A. Provide required size and type.
- B. Ball valves - As specified in Section 22 05 00, Basic Plumbing Requirements.
- C. Check valves - As specified in Section 22 05 00, Basic Plumbing Requirements.
- D. Pressure-relief valves - As specified in Section 22 05 00, Basic Plumbing Requirements.
- E. Provide vacuum relief valves with brass body, plastic protective cover, rated at 200 PSI, and conforming to ANSI Z21.22; Watts N36 or equal.
- F. Provide backflow preventers complying with local plumbing code and as listed by IAPMO.

2.05 PIPING ACCESSORIES

- A. Provide the required type and size.
- B. Nipples - Comply with FS WW-N-351, and of same type material as piping in which installed.
- C. Unions for Copper Tubing - Brass or bronze, with threaded or solder joint ends, conforming to FS WW-U-516.
- D. Provide split-hinged type escutcheons, locking type held in place using internal tension spring or setscrew. Exposed surface – Provide polished, chromium plated pressed steel. Escutcheons - Encompass sleeve or opening.
- E. Shock Absorbers – Provide bellows or diaphragm type, conforming to PDI WH-201.

- F. Machine Bolts and Nuts - Square head bolts and hexagonal nuts, not less than 1/4 inch. Bolts and nuts - Galvanized carbon steel, stainless steel or brass.
- G. Solder For Solder-jointed Tubing: - As specified in Section 22 05 00-, Basic Plumbing Requirements. Flux - Noncorrosive type conforming to FS O-F-506.
- H. Provide stainless steel expansion joints in domestic water lines located in under-platform exhaust (UPE) plenum, and where required. Use copper sweat ends for installation in copper lines. Rate expansion joints for a maximum operating pressure of 150 psi, designed for an axial movement of two inches compression and 1/2 inch expansion.
- I. Provide stainless steel expansion joints in domestic water lines where required. Use copper sweat ends for installation in copper lines. Rate expansion joints for a maximum operating pressure of 150 psi. Design for an axial movement of two inches compression and 1/2 inch expansion.

2.06 PAINTING

- A. As specified in Section 09 91 00, Painting and Coating.

2.07 SEISMIC RESTRAINTS

- A. As specified in Section 22 05 00, Basic Plumbing Requirements.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Keep pipe, valves and fittings clean before and during installation.

3.02 INSTALLATION

- A. Excavations for Water Supply System - As specified in Section 31 20 00, Earthwork.
- B. Provide concrete thrust blocks on elbows and tees in buried piping that has rubber gasket joints. Provide protective coatings in accordance with
- C. Section 22 05 00, Basic Plumbing Requirements.
- D. Cut pipe and tubing accurately to measurements established at Worksite and work into place without springing and forcing. Do not install water supply system pipe in trenches with sewer system pipe. Install water supply system piping with a fall towards the shut-off valve or lowest fixture. Provide branches from hot and cold water lines to fixtures, water heating units and outlets indicated.
- E. Pipe and Fittings – Shall be free from fins and burrs. Apply lubricant to screw joints on male threads only, cut threads full cut and do not leave more than three threads exposed after tightening. Apply red lead and oil paint to exposed ferrous pipe threads, after installation and testing.

- F. Cut ends of copper tubing square, and remove burrs and fins. Replace tubing dented or damaged with new tubing. Clean ends of tubing and fittings with a wire brush or abrasive. Apply rosin type flux to outside surface of tubing ends and on recess inside of fittings. Insert tubing full depth of fitting and solder. Remove stems and washers of solder-joint type valves before soldering.
- G. Install piping true to line and grade, supported and guided to ensure alignment under all conditions. Installed piping shall clear obstructions, preserve headroom, and keep openings and passageways clear.
- H. Valves shall be accessible for operation and servicing. Valves located in furred spaces shall be accessible through access panels. Install valves as indicated; do not install with stems located below horizontal position.
- I. Install unions at each connection to valves, equipment and tanks. Make-up shall be soldered-to-threaded connections with male thread-to-solder adapters.
- J. Cap or plug ends of pipes after installation of pipes. Do not bury, furr-in, or conceal piping before it is inspected and tested.
- K. Install expansion joints as recommended by the manufacturer. Properly guide and anchor piping as recommended by the Expansion Joints Manufacturers Association, or as required.
- L. Do not install water supply system piping inside traction power substations, train control and communication rooms, auxiliary power rooms, or incoming electric rooms.
- M. Excavations in which products are to be buried - Dry. Inspect surfaces and structures to, and on, which water supply system will be installed before beginning Work of this Section. Provide surfaces and structures capable of supporting system.

3.03 TESTING

- A. Test cold water system and hot water system, each hydrostatically in sections, in accordance with standard industry practice and as indicated to a pressure of at least 150 psi for not less than two hour with Contractor's QC Representative witnessing. Contractor's QC Representative to witness testing and to be notified of testing at least three days in advance of procedure. Pressure tests all pipes before burial and concealment. Repair leaks and retest system until system is leak free. Air pressure test instead of hydrostatic test will not be accepted.
- B. Perform pipe coating inspections and electrical tests on insulating flanges as specified in Section 22 05 00, Basic Plumbing Requirements.
- C. Insulating Flange Resistance Tests – Shall be as specified in Section 22 05 00, Basic Plumbing Requirements.
- D. Pipe Continuity Tests – Shall be as specified in Section 22 05 00, Basic Plumbing Requirements.

3.04 DISINFECTING - CONFORM TO AWWA C651.

- A. Before final acceptance of water supply system, disinfect each section of new line. Use one of following disinfectants:
 - 1. Mixture of water and chlorine gas
 - 2. Direct application of chlorine
 - 3. Mixture of water and calcium hypochlorite
 - 4. Mixture of water and calcium chloride.
- B. Before disinfecting, thoroughly flush line to remove dirt and extraneous materials. Clean each section of line between valves independently.
- C. Retain solution in pipe at least 24 hours. Following sterilization period, residual chlorine content at ends of section and at other representative points - Not less than fifty parts per million. Drain line and thoroughly flush with water until residual chlorine content is similar to that obtained from distribution system.
- D. Take water samples and test in accordance with AWWA C651.

3.05 PAINTING

- A. As specified in Section 09 91 00, Painting.

END OF SECTION

SECTION 22 13 00

SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing, installing and testing sanitary sewer system in station structures to a point outside structures.

1.02 RELATED SECTIONS

- A. Section 09 91 00: Painting and Coating
- B. Section 22 05 00: Basic Plumbing Requirements
- C. Section 22 05 53: Plumbing Systems Identification
- D. Section 22 09 00: Instrumentation and Controls for Plumbing
- E. Section 22 40 00: Plumbing Fixtures

1.03 REFERENCES

- A. ASTM International (ASTM)
 - ASTM A74 Cast Iron Soil Pipe and Fittings
 - ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - ASTM C1277 Shielded Couplings Joining Hub-less Cast Iron Soil Pipe and Fittings
- B. American Water Works Association (AWWA)
 - AWWA C110 Ductile iron and Gray-iron Fittings, 3 in. Through 48 in., for Water and Other Liquids
 - AWWA C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
- C. Cast Iron Soil Pipe Institute (CISPI)
 - CISPI 301 Hub-less Cast iron Soil Pipe and Fittings for Sanitary and Storm Drains, Waste and Vent Pipe Applications
 - CISPI 310 Couplings for Use in Connection with Hub-less Cast iron Soil Pipe and Fittings for Sanitary and Storm Drains, Waste and Vent Pipe Applications

D. Federal Specifications (FS)

FS WW-P-421 Pipe, Cast Gray and Ductile Iron, Pressure (for Water and Other Liquids)

E. Manufacturers Standardization Society (MSS)

MSS SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 Cast Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-72 Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-80 Bronze Gate, Globe, Angle and Check Valves

F. National Electrical Manufacturers Association (NEMA)

G. California Plumbing Code (CPC), 2019.

1.04 QUALITY ASSURANCE

A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).

B. Perform welding operations as specified in Section 05 05 33, Basic Welding Requirements.

1.05 SUBMITTALS

A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal requirements and procedures.

B. Shop Drawings and manufacturer's literature showing piping layouts, sizes, types, valves, drains, and cleanouts.

C. Equipment manufacturer's printed operating and maintenance instructions in accordance with Sections 11.3 and 11.7 of the General Requirements, consisting of detailed parts list, recommended spare parts list, and complete maintenance procedures.

D. Before testing, submit test procedures for review and acceptance.

E. Test reports

F. Code Data reports for ASME items requiring stamping.

G. Manufacturer's product data with catalog cuts and specifications for corrosion control materials as specified in Section 22 05 00, Basic Plumbing Requirements, Article 1.05.

H. As-Built Drawings - Maintain up-to-date, legible, accurate, dimensioned reproducible record of As-Built location of all work installed under this Contract for review and approval. As-Built Drawings as specified in Section 7.4 of the General Requirements.

- I. Seismic restraints for piping and equipment - As specified in Section 22 05 00, Basic Plumbing Requirements, Article 1.05.

1.06 DEFINITIONS (NOT USED)

1.07 WORKSITE CONDITIONS

- A. Maintain excavations dry immediately before, during, and after products are installed. Provide surfaces and structures to, and on, which sewage products will be installed capable of supporting products. Finish construction that will be concealed by sewage products before sewage products are installed.
- B. Prevent damage to protective pipe coatings during storage and delivery as specified in Section 22 05 00, Basic Plumbing Requirements, Article 1.06.
- C. Apply exterior pipe coatings only during favorable conditions of temperature and humidity as specified in Section 22 05 00, Basic Plumbing Requirements, Article 1.07.

1.08 COORDINATION

- A. Design drawings are diagrammatic. Do not scale drawings for exact location of installation; refer to dimensioned Shop Drawings.

PART 2 - PRODUCTS

2.01 BURIED SEWER PIPE AND FITTINGS

- A. Non-pressure Piping - Class B as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.01.

2.02 EXPOSED AND EMBEDDED SEWER SOIL, WASTE, DRAIN AND VENT PIPING

- A. Exposed Non-pressure Piping (Including above grade piping within accessible pipe chases) – Provide Class B as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.01.
- B. Embedded Non-pressure Piping – Provide Class C, DWV pattern, as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.01.

2.03 VALVES

- A. Provide the required valves and types.
- B. Globe Valves – Provide in accordance with MSS SP-80.
- C. Gate Valves – Provide bronze valves conforming to MSS SP-80, and cast iron valves conforming to MSS SP-70, as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.04.

- D. Check Valves – Provide bronze valves conforming to MSS SP-80, and cast iron valves conforming to MSS SP-71, as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.04.
- E. Check Valves – Shall be in accordance with MSS SP-80.
- F. Ball Valves – Provide bronze valves conforming to MSS SP-72, as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.04.

2.04 FLOOR DRAINS

- A. Refer to specification in Section 22 40 00, Plumbing Fixtures. Acceptable manufacturers: Zurn, J.R. Smith, Josam Company, or approved equal.

2.05 CLEANOUTS

- A. Shall be of required sizes. Provide cast iron conforming to ASTM A74.
- B. Floor Cleanouts
 1. For cast iron piping: Provide adjustable type with bronze plug, scoriated nickel-bronze cover; provide clamping device for cleanouts in floors with membrane waterproofing. Zurn ZN1400-BP-VP-NL or manufactured by J.R. Smith, Josam Company, or approved equal.
 2. For embedded PVC piping in areas with topping slab: Provide non-adjustable cleanouts with cast iron body, bronze plug, scoriated round nickel bronze top with vandal-proof screws and "Neo-Loc" outlet. Zurn ZN1402-BP-VP-NH or manufactured by J.R. Smith, Josam Company or approved equal.
- C. Wall Cleanouts – Provide bolted wedge type with cover and bronze plug. Cover –Shall be polished nickel-brass, with flanged frame secured to plug with vandal-proof screw.
- D. Exposed Cleanouts – Shall be tapered caulking ferrule and raised brass head cleanout plug.
- E. Grade Cleanouts – Shall be adjustable sleeve-type housing, countersunk threaded brass plug, and cast iron frame and cover.
- F. For special applications, submit proposed specialties for review. Provide cleanout access covers comparable to those specified above.

2.06 PIPING SPECIALTIES

- A. Gaskets for flanged joints – Provide full-face type of neoprene or rubber. Rubber gaskets – Shall conform to AWWA C111.
- B. Vent caps for service weight soil pipe – Shall conform to ASTM A74.
- C. Gaskets, glands and bolts for mechanical joint pipe and fittings – Shall conform to AWWA C110, AWWA C111 and FS WW-P-421.

- D. Unions for ferrous pipe three inches in diameter and smaller: Provide 150 psi steam-working-pressure zinc-coated malleable iron ground-joint type. Unions for ferrous pipe 3 1/2 inches in diameter and larger: Shall be 125 psi steam-working-pressure forged steel flange type, with gaskets 1/16 inch thick of rubber or cloth inserted rubber.
- E. Couplings for joining hub-less cast iron pipe and fittings – Provide no-hub coupling consisting of knurled stainless steel shield, clamp assembly, and a molded one-piece Neoprene sealing sleeve meeting ASTM C1277 and CISPI 310.
- F. Solder for solder-jointed tubing: Shall be 95 percent tin and five percent antimony. Flux – Provide noncorrosive conforming to FS 0-F-506
- G. Provide dielectric insulating fitting on pressurized or forced sanitary lines immediately inside an exterior wall, floor slab or roof slab penetration, and at joints between pipes of dissimilar metal as specified in Section 22 05 00, Basic Plumbing Requirements, except that a dielectric insulating fitting is not required between buried ductile iron and steel pipe unless required. Non-pressurized gravity lines do not require insulating joints or fittings at exterior wall, floor slab or roof slab.

2.07 FLASHING

- A. Provide soft-tempered or cold-rolled copper weighing not less than 16 ounces per square foot or sheet lead weighing not less than four pounds per square foot.

2.08 TRAPS

- A. Provide P type, unless otherwise required.
- B. Traps in Cast Iron Pipe – Provide standard weight cast iron.
- C. Traps in Steel Pipe – Provide threaded cast iron drainage pattern.
- D. Traps in Copper Pipe – Provide cast bronze.
- E. Traps in PVC-DWV – Provide PVC-DWV.
- F. Traps Exposed in Finished Spaces – Shall be chrome plated, cast brass.

2.09 TRAP PRIMERS

- A. Shall be as specified in Section 22 40 00, Plumbing Fixtures, Article 2.10.

2.10 SEEPAGE PANS

- A. Roof Drain Pans - Provide seepage pans of six pound sheet lead complete with flashing clamps and auxiliary drainage rims for roof drains. Turn pan up at ends and fold or properly seal corners. Thoroughly coat lead with asphaltum before placing lead in contact with concrete, or concrete fill is poured over lead.

- B. Floor Drain Pans - Provide seepage pans of six pound sheet lead or equivalent plastic complete with flashing clamps and auxiliary drainage rims for floor drains and total area of showers over open spaces. Turn pan up at ends at least nine inches and fold or properly seal corners.

2.11 ESCUTCHEONS

- A. Provide split-hinged, locking type held in place by internal tension spring or set-screw. Exposed surface - Polished chromium plated pressed steel. Escutcheon - Encompass sleeve or opening.

2.12 PAINTING

- A. To be provided under Section 09 91 00, Painting and Coating.

2.13 SEISMIC RESTRAINTS

- A. Shall be as specified in Section 22 05 00, Basic Plumbing Requirements, Article 2.01.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Excavations – Shall be free of water and extraneous material immediately before drainage products are placed. Form bottoms of trenches to support bottom quadrant of pipe and fittings. Rock and material unsuitable to support products at design elevation - Continue excavation to elevation eight inches below design elevation and backfill with sand.
- B. Clean interior of pipe, pipe fittings, valves, drains and cleanouts of foreign substances before installation.
- C. Install sleeves through walls, floors, roofs and other structures before sewage lines are installed.
- D. Maintain excavations dry immediately before, during, and after products are installed. Provide surfaces and structures to, and on, which sewage products will be installed capable of supporting products. Finish construction that will be concealed by sewage products before sewage products are installed.

3.02 INSTALLATION

- A. Install products as required. Remove and reinstall products disturbed after installation. Seal open ends of products at end of a work period; prevent water and foreign material from entering products; remove seals when Work resumes. Provide the required valve, plug or cap, and anchor ends of products to which future connections will be made. Make connections to existing facilities with fittings and short bends to suit actual conditions; connect products in accordance with product manufacturer's printed installation instructions. Coat threaded joints with lubricant and tighten to prevent leaks.

- B. Rest products to be buried on bottom of excavations and recess lower quadrant of pipe and fittings into bottom of excavation. Set pipe and fittings to line and grade before joints are made. Do not exceed angular deflections of joints recommended by pipe and fitting manufacturer. Should alignment require deflection of joints more than those recommended, use special bends to achieve the indicated deflection. Make up ring joints after retaining groove has been cleaned, and only after ring and groove have been lubricated.
- C. Encase buried cast iron soil pipe in polyethylene during installation as specified in Section 22 05 00, Basic Plumbing Requirements, Article 3.04.
- D. Products Not Buried - Secure to hanger supports and anchors. Make up flanged joints by tightening bolts and nuts sufficiently to prevent leaks.
- E. Slope horizontal soil and waste pipes as indicated; comply with local building codes. Extend main vertical soil and waste stacks full size to roof-line and above as vents, except where otherwise specifically specified. Run vent pipes in roof spaces as close as possible to underside of roof without forming traps in pipe; use fittings as required. If circuit vent pipe from fixture, or line of fixtures, will be connected to a vent line serving other fixtures, make connection at least six inches above flood-level of highest fixture served. Grade and connect vent and branch-vent pipes to drip back to vertical stack by gravity.
- F. Change pipe size on soil, waste and drain lines with reducing fittings. Change direction with 45 degree wyes, long or short-sweep 1/4, 1/6, 1/8 or 1/16 bends, or elbows.
- G. Slip Joints – Shall be permitted only in trap seals or on inlet side of traps. Make union connections with tucker or hub drainage fittings.
- H. Pipe and Fittings - Comply with manufacturers' recommendations. Do not miter joints for elbows or notch straight runs of pipe for tees. Threaded joints –Shall be American National taper pipe threads conforming to National Bureau of Standards Handbook H 28. Make joints with graphite or inert filler and oil, with approved graphite compound, or Teflon tape applied to male threads only.
- I. Joints in cast iron soil pipe and fittings using a double-seal, compression-type molded neoprene gasket - Provide modified hub to ensure positive seal. Provide polyethylene encasement during installation in accordance with AWWA C105.
- J. Cut copper tube square and remove burrs. Clean outside of tube where engaged in fitting, and inside of fitting in contact with tube, with abrasive material before soldering. Do not anneal tube and fittings when making connections. Core solder – Shall not be permitted. Make joints in copper tube 2 1/2 inches and larger with heat uniformly applied around entire circumference of tube and fittings by multi-flame torch.
- K. Tighten band (4-band) and screw assemblies used with hub-less type cast iron pipe to tighten each band screw to torque required by IAMPO listing; use torque wrench specifically designed for this purpose.
- L. Provide escutcheons at finished surfaces where exposed piping, bare or insulated, passes through floors, walls and ceilings. Fasten escutcheons to pipe or pipe covering.

M. Equip each fixture and piece of equipment connecting to sanitary sewer system with a trap. Place trap as near fixture as possible, and do not double-trap fixtures.

N. Drains

1. Depress floor drains below finished slab elevation as indicated on the architectural and structural drawings. Where not shown for areas with non-sloping floors, base top of drain elevations on floor depressions listed below:

DEPRESSION IN INCHES	RADIUS OF AREA DRAINED-IN FEET
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

2. Connect drains to sanitary sewer or storm sewer, as indicated. Drains to sanitary sewer must have a trap.
3. Install flashing collar, flange or seepage pans to prevent leakage between drain and adjoining materials.
4. Maintain integrity of waterproof membranes where penetrated.
5. Position drains to be readily accessible and easy to maintain.

3.03 PIPE CLEANOUTS

A. Same size as pipe, except not larger than four inches. Cleanouts for cast iron soil pipe - Long-sweep 1/4 bend or one or two 1/8 bends extended to place indicated; other cleanouts – Shall be T-pattern, 90 degree branch drainage fittings with screw plugs. Install cleanout tee branches with screw plug on each building drain.

3.04 SEISMIC RESTRAINTS

A. Shall be as specified in Section 22 05 00, Basic Plumbing Requirements, Article 3.14.

3.05 FIELD QUALITY CONTROL

- A. Perform testing under observation of Contractor's QC Representative. Notify Contractor's QC Representative at least three days before the tests.
- B. Do not cover products to be buried and do not paint products to be painted until inspected, tested and accepted.
- C. Test installed sewage lines and equipment, with Contractor's QC Representative in attendance, as follows:
 1. Fill gravity sewers and soil pipe with water and allow to stand not less than 30 minutes without leaking; temporarily seal low and intermediate branches. Provide test tees with cast iron screwed plugs in vertical stacks if sewers and soil pipe are to

be tested in sections. Test interior lines before lines are concealed. Repair leaks and retest systems until system exhibits no leaks. Head of water – Shall be not less than 10 feet.

2. Disconnect force mains from equipment, seal open ends; fill mains with water and hydrostatically test to a pressure of 50 psi greater than developed head pressure at lowest point in presence of Contractor's QC Representative. Maintain test pressure until force main system has been examined for leaks. Repair leaks and retest system until no leaks are observed.
 3. Test equipment operation and adjustment of controls. Repair or replace faulty equipment and controls.
- D. Weld Inspection and Testing - Perform non-destructive testing as follows, using services of a certified laboratory:
1. Visual Examination - All welds.
 2. If failure occurs in the first 10 percent sample, select second 10 percent sample and test. If no failure occurs in second 10 percent sample, represented welds shall be acceptable (rework failed sample in initial 10 percent sample). If failure occurs in second 10 percent sample, test 100 percent of welds.

3.06 PAINTING

- A. To be provided under Section 09 91 00, Painting and Coating.

3.07 CLEANING

- A. Remove foreign material from surfaces of installed products. Keep manufacturer's labels intact until Project has been approved, then remove.

3.08 REPAIR

- A. Repair pipe coating damaged during installation of pipe in accordance with Section 22 05 00, Basic Plumbing Requirements.

END OF SECTION 22 13 00

SECTION 22 33 00

DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing, installing, connecting and testing domestic water heaters.

1.02 RELATED SECTIONS

- A. Section 22 05 00: Basic Plumbing Requirement,

1.03 REFERENCES

- A. Restrain water heating equipment in accordance with local code and referenced standard for seismic forces.
- B. American National Standards Institute (ANSI):
ANSI Z21.22 Relief Valves for Hot Water Supply Systems
- C. American Society of Mechanical Engineers (ASME):
ANSI/ASME PTC 25 Pressure Relief Devices – Performance Test Codes
- D. American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE)
ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings
- E. California Code of Regulations (CCR):
CCR Title 24 Part 4, California Mechanical Code
CCR Title 24 Part 5, California Plumbing Code
CCR Title 24 Part 6, California Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Seismic Restraint Manual Guidelines for Mechanical Systems

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).

- B. Qualifications - Select a manufacturer who has been engaged in production of similar domestic water heaters.
- C. Water heater shall comply with California Building Energy Efficiency Standards for Residential and Nonresidential buildings.
- D. Design and installation shall conform to California plumbing Code and California Mechanical Code.

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal requirements.
- B. Manufacturer's product data.
- C. Operation and Maintenance Data: Provide in accordance with Section 11.3 of the General Requirements, Include manufacturer's operating and maintenance instructions for equipment operation.
- D. Shop Drawings indicating following:
 - 1. Dimensions.
 - 2. Details of construction, including control systems, safety devices, Cathodic protection and type of tank insulation.
 - 3. Materials.
 - 4. Heating capacity.
 - 5. Code construction.
- E. Provide Warranty.

1.06 DEFINITIONS (NOT USED)

1.07 WORKSITE CONDITIONS

- A. Inspect surfaces and structures to, and on, which equipment will be installed before beginning Work of this Section. Finish surfaces inaccessible after equipment has been installed before installing equipment. Install, test and have approved electrical and mechanical products which will serve equipment before equipment is started and operated.

1.08 COORDINATION

- A. Design drawings are diagrammatic. Do not scale drawings for exact location of installation; refer to dimensioned Shop Drawings.

PART 2 - PRODUCTS

2.01 ELECTRIC WATER HEATER – INSTANTANEOUS TYPE

- A. Provide UL listed, UL labeled, and instantaneous-type water heater. Size water heater based on plumbing fixture demand.
- B. Manufacturer: Subject to compliance with requirements, provide product by one of the following manufacturers or approved equal.
 - 1. Eemax Inc
 - 2. Chronomite Laboratories Inc
 - 3. Hubbell Heaters Company
- C. Materials:
 - 1. Outer shell – Shall be steel with baked-on enamel finish.
- D. Heaters – Shall be free of the followings:
 - 1. Sharp edges.
 - 2. Scratches on enameled surfaces.
 - 3. Loose screws.
 - 4. Loose panels.
 - 5. Dents on outer shell.
- E. Service Conditions:
 - 1. Provide completely factory-assembled domestic water heaters.
 - 2. Factory set for a maximum delivery temperature of 105 deg F.
 - 3. Heating elements and appurtenances shall conform to CCR Title 24.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install heater, piping and accessories in accordance with manufacturer's installation instructions.

3.02 FLUSHING AND TESTING

- A. Flushing - After piping, valves and accessories are connected, but before startup and testing, flush heater unit under full system pressure, with Contractor's QC Representative in attendance; notify Metro at least three days in advance of procedure.
- B. Startup and Testing

1. Startup – Shall be after flushing, drain heater tank, refill tank, and start up unit in accordance with manufacturer's operating instructions.
2. Test heater unit after field adjustments have been made. Retest until specification requirements have been met.
3. Testing shall be witnessed by Contractor's QC Representative.

3.03 ADJUST AND CLEAN

- A. Adjust thermostat to desired outlet water temperature.
- B. Clean - Upon completion of testing and adjusting, clean parts of heater unit to remove grease, sludge and foreign substances.

3.04 SEISMIC RESTRAINTS

- A. Install seismic restraints in accordance with local plumbing code. Section 22 05 00, Basic Plumbing Requirement.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work specified in this Section consists of furnishing, installing and testing plumbing fixtures as indicated

1.02 RELATED SECTIONS

- A. Section 10 28 13: Toilet Accessories
- B. Section 07 92 00: Joint Sealants
- C. Section 22 05 00: Basic Plumbing Requirements
- D. Section 22 07 00: Plumbing Insulation

1.03 REFERENCES

- A. American National Standards Institute (ANSI):
 - ANSI/ASME A112.6.1M Supports for Off-the-Floor Plumbing Fixtures for Public Use
 - ANSI/NSF 61 Drinking Water System Components-Health Effects
 - ASME A112.18.1 Plumbing Fixture Fittings
 - ASME A112.19.2 Ceramic Plumbing Fixtures
- B. American Society of Sanitary Engineering (ASSE):
 - ASSE 1011 Performance Requirements for Hose-Connection Vacuum Breakers
 - ASSE 1052 Performance Requirements for Hose Connection Backflow Preventers
- C. California Code of Regulations (CCR):
 - CCR Title 1 General Provisions
 - CCR Title 24 Part 5, California Plumbing Code
- D. Federal Specifications (FS):
 - FS WW-P-541 Plumbing Fixtures
 - FS WW-P-541/1 Plumbing Fixtures (Water Closets)

FS WW-P-541/2	Plumbing Fixtures (Urinals)
FS WW-P-541/5	Plumbing Fixtures (Sinks, Kitchen, Service)
FS WW-P-541/6	Plumbing Fixtures (Drinking Fountains)

- E. International Code Council (ICC)
 - ICC A117.1 Standard on Accessible & Usable Buildings and Facilities
- F. National Fire Protection Agency (NFPA)
 - NFPA 70 National Electric Code

1.04 QUALITY ASSURANCE

- A. Comply with Project Quality Control / Quality Assurance Plan (QCQAP).
- B. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- C. Electrical Components, Devices, and Accessories: Shall be UL listed and comply to NFPA 70, National Electric Code, and authorities having jurisdiction, and marked for intended use.
- D. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Provide products with the model numbers specified in this section.
 - 1. Exception: If a model number has become superseded then provide equal product with the same quality, performance, and specifications from the same manufacturer; or approved equivalent.

1.05 SUBMITTALS

- A. Refer to Sections 5.3.5.3 and 10.0 of the General Requirements for submittal requirements and procedures.
- B. Manufacturer's Product Data: For each type of plumbing fixture specified shall

1. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports.
 2. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- C. Operation and Maintenance Data shall be provided in accordance with Section 11.3 of the General Requirements. The plumbing fixtures shall include emergency operation, and maintenance manuals.
- D. Shop Drawings: Submit power, signal, and control wiring diagrams.
- E. Warranty: Provide special warranty.
- F. Test Reports: Provide test reports.

1.06 DEFINITIONS (NOT USED)

1.07 COORDINATION

- A. Design drawings are diagrammatic. Do not scale drawings. For exact installation location; refer to Shop Drawings for dimensions.

1.08 WORKSITE CONDITIONS

- A. Inspect surface and structures on or to which plumbing fixtures will be installed before beginning Work of this Section. Finish surfaces concealed by plumbing fixtures before fixtures are installed.

PART 2 - PRODUCTS

2.01 WATER CLOSET (STAFF USE)

- A. Water closet shall be vitreous china wall-hung, elongated bowl type with 1.28 gallon/per flush consumption, large diaphragm flush valve, siphon jet flushing action, back outlet, with carrier and open front fire retardant seat in white color, less cover; design fittings for wall hung water closet.
- B. Water closet shall conform to ASME A112.19.2 Exception: Water closets for physically-handicapped shall conform to CCR, Title 24. Carrier shall conform to requirements of ASME A112.6.1M and ASME A112.19.2. Mounting height shall be as indicated.
- C. Acceptable manufacturers are:

1. Bowl:

AMERICAN STANDARD	KOHLER	SLOAN	ZURN
Afwall 3351.001	K-4325	ST-2050-A-1.28	Z-5615-BWL

2. Automatic Flush Valve (Battery-Powered):

AMERICAN STANDARD	SLOAN	ZURN
Selectronic 6065.121 (1.28 gpf)	Royal 111-1.28 ES-S-TMO High Efficiency (1.28 gpf)	ZEMS6000PL-HET (1.28 gpf)

3. Seat: shall be White and ring thickness including bumpers shall be maximum one inch.

OLSONITE	BEMIS	CENTOCO
10SSCTFR	10SSCTFR	AMFR500STSCSS

4. Carrier:

WATTS	ZURN
ISCA-102 Or ISCA-122 (to suite installation condition)	Z1203 Or Z1204 (to suite installation condition)

2.01A WATER CLOSET (PUBLIC) Refer to drawing P0.2 for information.

2.02 LAVATORY (STAFF USE)

- A. Lavatories shall be one-piece, wall-mounted type, vitreous china, with supports, trim, fittings, lever operated faucet and a rectangular bowl suitable for installing soap dispenser. Equip lavatories in toilet rooms with following:

1. Outlet devices to limit flow of hot water to a maximum of 0.5 gallon per minute, or equip with spring loaded auto-closing faucets to limit delivery to a maximum of 0.25 gallon per minute of hot water for re-circulating systems and to a maximum of 0.5 gallon per minute for non-re-circulating systems.
2. Devices to limit outlet temperature to a maximum of 110°F.
3. Separate lavatories for physically handicapped persons - Do not use self-closing faucets unless faucets remain open at least 10 seconds.

- B. Conform to CCR, Title 1 Chapter 25 Division 7. Carrier shall conform to requirements of ASME A112.6.1M. Exception: lavatories for physically-handicapped shall conform to CCR, Title 24. Mounting height shall be as required.

- C. Acceptable manufacturers are:

1. Bowl:

AMERICAN STANDARD	TOTO	KOHLER
9141.029 OR 9141.035 (to suit architectural features for station)	LT308.4A	K-2005-0 (to suit architectural features for station)

2. Offset Grid Drain, Carrier and Insulated Cover:

	KOHLER	PLUMBEREX	SYMMONS	ZURN
Faucet	-	-	S-60-H	-
Offset Grid Drain	K-7131-A	-	-	Z-8945-NT
Carrier	-	-	-	Z1231
Insulated Cover	-	Pro-Extreme X-4444	-	-

2.02A LAVATORY (PUBLIC) Refer to drawing P0.2, plumbing fixture schedule for information.

2.03 ANGLE, STRAIGHT AND INTEGRAL STOPS

- A. Lock-shield, loose-key pattern type with supplies. Exposed fixture fittings and trim - Chromium-plated or nickel-plated brass, having polished, bright surfaces, and in accordance with Section 22 05 00, Basic Plumbing Requirements.

2.04 HOSE BIBS

- A. Hose bibs shall be brass, with wheel handles in non-public areas and loose key handles in public areas. Inlet: Shall be 1/2 inch external pipe thread. Spout: Shall be 3/4 inch hose thread. Hose bibs – Shall be suitable for potable water service, furnished with a vacuum breaker (or at Contractor's option, hose connection backflow preventer) conforming to the local plumbing code.
- B. HB-1 – Hose Bibb (with vacuum breaker for potable water service - install in box which is provided as part of the fire hose cabinet base; Acceptable: Shall be Woodford or approved equal with vacuum breaker approved under ASSE 1011 and loose key tee handle.

2.05 CONNECTORS

- A. Provide anchoring bolts not smaller than 1/4 inch of carbon steel, and with chromium-plated nuts and washers.
- B. Connectors for connecting earthenware fixtures to flanges of soil pipe - Closet-setting non-rubber compound or a neoprene gasket and seal.

2.06 VACUUM BREAKER

- A. Size vacuum breaker to ensure air area equivalent to piping served, and conforming to local plumbing code.

2.07 TRAP PRIMERS

- A. Provide floor drain trap primer valves with associated piping as indicated, to automatically maintain constant water seal in floor drain traps. Provide machined brass

primer valves, adjustable to line pressure and to desired delivery amount and suitable for an operating pressure range of 20 to 75 psig. If required, provide distribution units to prime more than one floor drain. Acceptable manufacturer: Shall be Sioux Chief 695-01 with distributors/splitters to suit installation location.

2.08 SEISMIC RESTRAINTS

- A. Provide Seismic Restrainers in accordance with Section 22 05 00, Basic Plumbing Requirements.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Inspect products for defects before installation. Remove and replace defective products with new products.
- B. Provide sleeves in structure to accommodate fixture installation. Roughing-in dimensions – Shall conform to plumbing fixture manufacturer's installation instructions.
- C. Install floor drain trap primers in accordance with manufacturer recommendation. Install trap primers level, having access for periodic inspection.

3.02 INSTALLATION

- A. Install fixtures where as required.
- B. Secure fixtures to supporting surfaces with metal screws or metal bolts. Set fixtures with outlet flanges to supporting surfaces. Make connections between earthenware fixtures and flanges of soil pipe gastight and watertight.
- C. Install water supply pipes at right angles to wall and floor. Connect exposed traps and exposed supply lines to roughed-in piping system at wall, unless otherwise indicated.
- D. At accessible pipe chase, locate individual fixture shut-off-valve(s) within chase; exception: integral stops, i.e. flush valves.
- E. For handicapped accessible fixture, install flush valve handle toward wide side of stall or space.
- F. For handicapped accessible fixture with exposed trap and/or fixture supplies, install protective insulating cover(s) in accordance with manufacturer's recommendation.
- G. Caulk fixtures to adjacent surfaces using appropriate waterproofing sealant; see Section 07 92 00, Joint Sealants.
- H. Insulate exposed hot water and drainpipes under lavatory as specified in Section 22 07 00, Plumbing Insulation, and in accordance with CCR, Title 24 requirements. Modify lavatory to provide Opening for liquid soap dispenser as specified in Section 10 28 00, Toilet Accessories.

3.03 FIELD QUALITY CONTROL

- A. Test, with Contractor's QC Representative in attendance, installed products for operability in accordance with each manufacturer's printed instructions.

3.04 ADJUSTING AND CLEANING

- A. Adjust installed products in accordance with respective manufacturer's operating instructions. Leaks are not permitted; eliminate objectionable operating noise as required.
- B. Remove foreign material from surfaces of products. Leave manufacturer's labels intact until Contract has been approved.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. CPVC: Chlorinated polyvinyl chloride plastic.
 2. PE: Polyethylene plastic.
 - a. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BA_g1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
 - b. Or approved equal.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
 - b. Or approved equal.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO, Inc.; Chemtrol Div.
 - b. Or approved equal.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - h. Or approved equal.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Or approved equal.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or approved equal.
 - 1) Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - c. Or approved equal.
- G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
 - e. Or approved equal.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or approved equal.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel and Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

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

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

2.8 ESCUTCHEONS

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

2.9 GROUT

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

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

- S. Verify final equipment locations for roughing-in.

- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

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

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

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

3.9 GROUTING

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

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC 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 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.

1.3 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 requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

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. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. 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.
- K. Enclosure Material: Cast iron for motor frame sizes 15 HP and larger; rolled steel for motor frame sizes smaller than 15 HP.

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.

- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC 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 hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.

- B. Shop Drawings:[Signed and sealed by a qualified professional engineer.] Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Pipe stands. Include Product Data for components.
 - 5. Equipment supports.

- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.

3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, calcium silicate, or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.6 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.

- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. MIRO Industries.

- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - d. Base: Stainless steel.
 - e. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - f. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Manufacturers:

ICTC Calexico Intermodal Transit Center

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

IFB Deliverable

23 05 29 - 4
02/01/24

- a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, non-corrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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 20 (DN 20 to DN 500).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

- G. 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.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- H. 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. 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.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (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.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - f. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
 - g. Insert Material: Length at least as long as protective shield.
 - h. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 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 smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

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

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC 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. Spring hangers.
 - 3. Spring hangers with vertical-limit stops (For supply and return ducts).
 - 4. Restraining braces and cables.
 - 5. Vibration spring isolator with steel rail.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. 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.
 - 1. 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. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - d. Pre-approval 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).

- B. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- C. Welding certificates.
- D. Qualification Data: For professional engineer and testing agency.
- E. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 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 pre-approval OPA number from pre-approval by ICC-ES, or pre-approval 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 pre-approved 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 a comparable product by one of the following:
 1. M. W. Sausse.
 2. Mason Industries.
 3. California Dynamics Corporation.

ICTC Calexico Intermodal Transit Center

VIBRATION AND SEISMIC FOR HVAC PIPING AND EQUIPMENT

IFB Deliverable

23 05 48 - 2
02/01/24

- D. Neoprene Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment. Neoprene pad shall be Vibrex RPG-E.
 - 1. Resilient Material: Oil- and water-resistant neoprene and rubber hermetically sealed compressed fiberglass.(For boilers B-1 and B-2)

- E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint. Vibrex type RMS BP-3200.
 - 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.

- F. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression. (Vibrex type RMX-A with cable bracings for exhaust fans, supply and return duct).
 - 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.

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:

- 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 a comparable product by one of the following:
 - 1. M.W. Sausse.
 - 2. Mason Industries.
 - 3. California Dynamics Corporation.
 - 4. Hilti Inc.
 - 5. TOLCO Incorporated; a brand of NIBCO INC.

6. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications 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.
- 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 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. 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.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. 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.
- L. 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.

2.3 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. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

2. 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 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. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 1. Install seismic snubbers on HVAC 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 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.
- C. 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).
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.

- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. 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.
- H. 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.
 - 1. Drilled-in Anchors:
 - a. 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 pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - b. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - c. 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.
 - d. 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.
 - e. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - f. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC 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

- 1. Section Includes:
 - a. Equipment labels.
 - b. Warning signs and labels.
 - c. Pipe labels.
 - d. Duct labels.
 - e. Stencils.
 - f. Valve tags.
 - g. Warning tags.

1.3 SUBMITTALS

- 1. Product Data: For each type of product indicated.
- 2. Samples: For color, letter style, and graphic representation required for each identification material and device.
- 3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- 4. Valve numbering scheme.
- 5. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- 1. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- 2. Coordinate installation of identifying devices with locations of access panels and doors.
- 3. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- 1. Metal Labels for Equipment:
 - a. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - b. 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).
 - c. 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.
- d. Fasteners: Stainless-steel self-tapping screws.
- e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 2. Plastic Labels for Equipment:
 - a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm thick, and having predrilled holes for attachment hardware.
 - b. Letter Color: Blue.
 - c. Background Color: Black.
 - d. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - f. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - g. Fasteners: Stainless-steel self-tapping screws.
 - h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 3. 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.
- 4. 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

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Blue.
3. Background Color: Black.
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 self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
4. 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.
 - a. 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.
 - b. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 DUCT LABELS

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Blue.
3. Background Color: Black.
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 self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - a. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - b. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 STENCILS

1. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - a. Stencil Material: Brass.
 - b. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - c. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

1. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - a. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - b. Fasteners: Brass [wire-link or beaded chain; or S-hook.
2. 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.
 - a. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

1. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - a. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - b. Fasteners: Reinforced grommet and wire or string.
 - c. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE", "HAZARDOUS MATERIAL."
 - d. Color: Yellow background with black lettering.

2.8 IDENTIFICATION OF AIR CONDITIONING EQUIPMENT

1. Provide identification markers to locate air conditioning equipment above T-bar ceilings. Install 3/4 inch to one inch diameter colored self adhesive dots to T-bar ceiling grid indicating point of access. The following identification markers shall be recorded on the project record documents.

a. Fire Damper:	Red
b. Manual Volume Damper	Blue
1) Supply Air:	Full Dot
2) Return Air:	Half Dot
c. Fan Coil Unit:	Green
d. Filter Location if separate from fan coil:	Yellow

PART 3 - EXECUTION

3.1 PREPARATION

1. 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

1. Install or permanently fasten labels on each major item of mechanical equipment.
2. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

1. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
2. 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, on each piping system.
 - a. Identification Paint: Use for contrasting background.
 - b. Stencil Paint: Use for pipe marking.
3. 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:
 - a. Near each valve and control device.
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - c. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.

- f. 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.
- g. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 4. Pipe Label Color Schedule:
 - a. Refrigerant Piping:
 - 1) Background Color: Black.
- 5. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - a. Black: For cold-air supply ducts.
 - b. Black: For hot-air supply ducts.
 - c. Black: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - d. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- 6. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.
- 7. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.4 WARNING-TAG INSTALLATION

- 1. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93

HVAC TESTING, ADJUSTING, AND BALANCING

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.
- B. Where contradictions occur between this Section and Division 01, and between contract specifications and drawings, the more stringent of the two shall apply. The Owner's Representative shall decide which is most stringent.

1.2 SUMMARY

- A. Furnish the services and coordination required for a completely balanced, tested and certified air and water systems including testing and pre-certification of "operating/clean" rooms at as-built condition.
- B. The work shall be accomplished by the services of a Contractor-furnished air-balance and testing (TAB) agency that specializes in the balancing and testing of heating, ventilating, and air conditioning systems, to balance, adjust and test air moving equipment, duct mounted smoke detectors, air distribution systems, and water systems as specified.
- C. Work to include all HVAC systems serving parking garage.
- D. Coordinate with HVAC and control contractors for additional testing required for city acceptance of smoke control system. See Section 230900, INSTRUMENTATION AND CONTROL FOR HVAC.
- E. Coordinate all activities with the designated Commissioning agent and Owner's third party test/balance inspector.

1.3 TOTAL SYSTEM BALANCE

- A. Performance Testing and/or Balancing of the Air Conditioning Include:
 - 1. Fan systems.
 - 2. Single duct systems using air valves.
 - 3. Duct leakage testing
 - 4. Temperature control systems.
 - 5. Report analysis and verification.
 - 6. Air-Handlers.
 - 7. Fan coil Units.
 - 8. NOTE: Sections referred to herein are detailed in the current edition of The National Standards Manual of the Associated Air Balance Council.

1.4 SUBMITTALS

- A. First Submittal:
 - 1. Submit three (3) copies of documentation to confirm compliance with quality assurance provisions:

- a. Organization, supervisor and personnel training, and qualifications.
 - b. Specimen copy of each of the report forms proposed for use. Forms shall be equivalent to those shown in the latest "National Standards for the Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" of the AABC.
 - c. General plan of testing procedures and sequences.
- B. Second Submittal: With the initial HVAC shop drawing and at least sixty (60) days prior to starting field work, submit three (3) copies of:
- 1. A set of report forms filled out as to the design flow values and the installed equipment pressure drops, and the required CFM for air terminals.
 - 2. A complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each. Show:
 - a. Manufacturer and model number.
 - b. Description and use when needed to further identify the instrument.
 - c. Size or capacity range.
 - d. Latest calibration date.
 - 1) A detailed description of the balancing and testing procedures. These procedures shall conform to AABC requirements and recommendations.
 - 2) Owner's Representative will review submittals for compliance with Contract Documents, and will return one set marked to indicate:
 - a) Discrepancies noted between data shown and Contract Documents.
 - b) Additional or more accurate instruments required.
 - c) Requests for re-calibration of specific instruments.
 - d) Expansion or abbreviation of the test procedures and sequences.
- C. Third Submittal: The testing agency shall perform the tests described, compile the test data, and submit seven (7) copies of the complete test data to Contractor for forwarding to Owner's Representative for approval within (10) working days of completion.
- 1. Report shall contain, at minimum, the following:
 - a. Project cover sheet.
 - b. Project summary/general comments.
 - c. Log data and reference records.
 - d. Calibration certificates for all test equipment used on project including model and serial number.
 - e. Drawings: The Air Balance Agency shall prepare a complete set of full scale drawings showing actual duct runs and outlet/inlet locations. Drawings shall be keyed to and furnished with the Air Balance Report. The HVAC design drawings are not acceptable for this purpose. Drawings shall be in AutoCAD latest version.
 - f. AABC National Performance Guaranty.
 - 2. Submit Test and Balance Agency qualifications per Paragraph 1.2.2 herein, within 30 days after notice to proceed.

1.5 QUALITY ASSURANCE

- A. Testing Agency (General and HVAC Systems):
- 1. All Work by this agency shall be done under direct supervision of a qualified balancing and testing professional certified by AABC. All instruments used by this agency shall be accurately calibrated and maintained in good working order. Testing procedure shall be as specified in PART 3 – EXECUTION, herein. The tests shall be conducted in the presence of Owner's Representative and Owner's HVAC Inspector.
 - 2. Total System Balance shall be performed by an independent, non-affiliated agency certified by the Associated Air Balance Council (AABC) which specializes in and whose business is dedicated to testing, adjusting and verification of the HVAC system performance.

3. The submittal of reports shall be timely upon completion of work. This work shall conform to AABC specifications referred to in the AABC National Standard and other criteria as set forth in this specification.
 4. The Contractor shall procure the services of an independent testing and balancing agency, with previous consent of the District Representative. The Testing and Balancing Agency shall specialize in testing and balancing of heating, ventilating, air-moving equipment, air-conditioning system and Hydronic systems. The testing agency shall provide proof of having successfully completed at least five projects of similar size and scope, and shall be a certified member of the Associated Air Balance Council and/or National Environmental Balancing Bureau, unless otherwise approved. The Mechanical Contractor shall award the test and balance contract to the selected agency as soon as possible after approval of the agency by the District Representative.
 5. Furnish written proof that testing agency has not been called before the AABC Board or placed on probation at any time during the past five (5) years.
- B. In addition to testing requirements set forth herein, the Owner's Representative will randomly select and direct the Contractor to test 10% of the diffusers, grilles, air handling equipment or devices to confirm the system has been properly balanced in accordance with the contract documents. It is the Owner Representative's discretion that the system(s) and/or devices shall be rebalanced at no additional cost if the random testing indicates that the selected air devices or equipment does not meet the design airflows.

1.6 PRODUCT CONDITIONS

- A. General:
1. Notify Owner's Representative when any test is ready to be performed. Owner's Representative is to be present for all tests including air balance.
 2. Furnish all equipment required for testing including fittings for additional openings and all openings required inside and outside the building.
 3. After the inspection has been approved, or portions thereof, certify in writing the time, date, name and title of the person approving the test. This shall also include the description and what portion of the system has been approved. The person making the inspection shall sign the certification.
 4. A complete record shall be maintained of all testing that has been approved, and shall be made available at the Project site to all authorities concerned.
 5. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to Owner's Representative.
 6. Defective work or material shall be replaced or repaired as necessary at no additional cost to Owner and the inspection and test repeated at Contractor's expenses. Repairs shall be made with new materials. No caulking of screwed joints or holes will be acceptable.
 7. Isolate all equipment subject to damage from test pressure. Make no test against a service valve or meter.
- B. Timing of Tests: Two weeks before expected completion date, put all systems and equipment into operation and continue operation of same during each working day, but not less than five 8-hour periods, until demonstration of all adjusting, balancing and testing has been approved.
- C. Functional Tests: Any installed item not meeting the schedule or specified performance shall be removed and replaced with items whose performance is in accordance with the Drawings and Specifications at no additional cost to Owner.
- D. After all systems have been completely installed, connections made and tests completed, make arrangements with Owner's Representative to operate the systems for a period of ten (10) working days during the hours of a normal working day.

- E. Notify Owner's Representative in writing when the operational period may start and the time for this period shall be scheduled by mutual agreement.
- F. During this operation period, instruct Owner's operating personnel in accordance with written instructions of the Service Manual specified.
- G. Perform tests as specified and as requested by Owner's Representative to prove installation is in accordance with Contract requirements. Perform tests in presence of Owner's Representative, and furnish test equipment, facilities, and technical personnel required to perform tests.
- H. Coordination: Promptly report to Owner's Representative any deficiencies noted during performance of services. Contractor shall rectify these deficiencies, and any tests interrupted shall be re-done at no additional cost to Owner.
- I. Test Failures: Notify General Contractor to repair duct system if test pressure and leakage is not attained. Repairs and sealing to be done with sheet metal and sealant by HVAC Contractor Division 23.

1.7 WORK BY HVAC SUBCONTRACTOR

- A. Preparation: Before any testing or balancing operations are started, the HVAC Subcontractor shall adjust belts and sheaves, align parts, oil and grease bearings in accordance with manufacturer's instructions, clean exterior surfaces of coil tubes and fins, flush interior of coil tubes until clean and check mixing damper operation to insure free operation and activation by correct thermostat. Install filters and startup equipment.
- B. Certification: HVAC Subcontractor shall certify in writing that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but HVAC Subcontractor's certification that prime movers, fans, pumps, refrigeration machines, boilers, etc., are installed in good working order, and full load performance has been preliminarily tested under certification of HVAC Subcontractors. Before any testing and balancing is started, a complete report shall be sent to the Agency. Refer to Part 4 of this Section for Checklist forms to be completed by the HVAC Subcontractor.

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 - EXECUTION

3.1 GENERAL

- A. The Test and Balance Agency (TAB) shall be provided with:
 1. Within thirty (30) days after agency selection:
 - a. Construction drawings

- b. Equipment Specification
- c. Written contract
 - 1) As Issued or Received:
 - a) Change orders.
 - b) Equipment manufacturer's submittal data.
 - c) HVAC shop drawings.
 - d) Temperature control drawings.
 - e) Project Schedule.
 - f) Completely operable system.
- 2. Before testing and balancing is started, the HVAC installer shall, adjust belts and sheaves, align all parts, oil and grease bearings in accordance with manufacturer's instructions, clean exterior surfaces of coil tubes and fins, flush interior of coil tubes until clean and check damper operation to ensure free operation and activation by the correct thermostat.
- 3. Submit written certification by the HVAC Installer that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but the HVAC Installer's certification that the prime movers, fans, pumps, refrigeration machines, boilers, etc. are installed in good working order, and the full load performance has been preliminarily tested under the certification of the HVAC Installer. Before any testing and balancing is started, a complete report shall be sent to the Test and Balance Agency. Refer to Part 4 herein for Hydronic and Air Handling System Checklists.
- 4. Make all modifications to rectify discrepancies reported by the Balancing Contractor as indicating non-compliance with the Contract Documents.
- 5. The air system shall be adjusted to obtain the air volumes specified, but readjusted if required to obtain design temperature in each room. Make drive changes, install additional dampers, vanes, grille baffles, etc., as may be required on the job to achieve correct operation and design conditions.

3.2 BALANCING

A. Air Systems:

- 1. Preparation of Duct System:
 - a. All supply and return air duct dampers are set at full open position.
 - b. All diffuser and sidewall registers are set at full open position.
 - c. Outside air damper is set at minimum position.
 - d. All controls checked and set for full cooling cycle.
 - e. Branch line splitter dampers to open position.
 - f. Set all extractors and distribution grids to wide-open position.
- 2. Preparation of Air Handler:
 - a. Drill all probe holes for static pressure readings, pitot tube traverse readings and temperature readings.
 - b. Check motor electrical current supply and rated-running amperage of fan motors.
 - c. Check available adjustment tolerance.
- 3. Main Duct Proportioning:
 - a. Make first complete air distribution run throughout entire system, recording first run statistics.
 - b. Using pitot tube traverse in all main duct and branch duct supply and return, proportion all air in required amounts to the various main duct runs and branch runs.
 - c. All fan systems with filters shall be balanced to the air flows as shown on the drawings based on the filter final pressure drop as shown on the equipment schedule. Apply an artificial pressure to match the filter final pressure drop. Balance the airflows to the quantities as shown on the drawings. Make readings and record on report. Remove the artificial pressure drop.

- d. Make second complete air distribution run throughout entire system for check on proper proportion of air.
- 4. Inlet and Outlet Proportioning:
 - a. Using pitot tube traverse, set all main line dampers to deliver proper amount of CFM to all areas.
 - b. Using pitot tube traverse, set all branch line dampers to deliver proper amount of CFM to diffusers and sidewall supply grilles in each zone.
 - c. Read CFM at each outlet and adjust to meet requirements.
 - d. Test and record all items as listed (Testing Procedure).
- 5. Testing Procedure for Air Systems:
 - a. Test and adjust blower RPM to design requirements.
 - b. Test and record motor full load amperes.
 - c. Make pitot tube traverse of main supply ducts and obtain design CFM at fans where applicable.
 - d. Test and record system static pressures, suction and discharge.
 - e. Test and adjust system for design recirculated air CFM.
 - f. Test and adjust system for design CFM outside air.
 - g. Test and record entering air temperatures. (D.B. heating and cooling.)
 - h. Test and record entering air temperatures. (W.B. cooling.)
 - i. Test and record leaving air temperatures. (D.B. heating and cooling.)
 - j. Test and record leaving air temperatures. (W.B. cooling.)
 - k. Adjust all main supply and return air ducts to proper design CFM.
 - l. Adjust all zones to proper design CFM supply and return.
 - m. Test and adjust each diffuser, grille and register to within 10% of design requirements. Supply, return, and/or exhaust air quantity relationship shall be maintained as shown on drawings so that the room will maintain the proper air pressurization (positive, negative or equal).
 - n. Each grille, diffuser and register shall be identified as to location and area.
 - o. Size, type, and manufacturer of diffusers, grilles, registers, and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.
 - p. Readings and tests of diffusers, grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustments.
 - q. In cooperation with control manufacturer's representative, setting adjustments of automatically operated dampers to operate as specified, indicated or noted.
 - r. All diffusers and registers shall be adjusted to minimize drafts in all areas.
 - s. As a part of the Work, the HVAC installer shall make all changes in the pulleys, belts, and dampers or the addition of dampers required for correct balance, as recommended by the Air Balance Agency, at no additional cost to Owner.
 - t. Provide static pressure profile for air handling units showing pressure drop of individual internal component sections (e.g., coil, filter, sound traps, inlet and discharge sections, etc.)

3.3 SPACE DIFFERENTIAL PRESSURE MEASUREMENTS

- A. Pressure measurements are recorded in inches water gauge.

3.4 TESTING PROCEDURE FOR DUCT MOUNTED SMOKE DETECTORS

- A. When air system testing and balancing is completed, the balance agency shall verify proper location and operation of duct mounted smoke detector. Smoke detectors shall be installed per NFPA 72 and the manufacturer's recommendations.

3.5 DUCT PRESSURE/LEAK TESTING

- A. Test shall be in accordance with of the National Standards Manual of the Associated Air Balance Council.
- B. HVAC Contractor to close off and seal all openings in the duct section to be tested as specified by the Air Balance Contractor.
- C. Test duct in sections, not exceeding 150 feet for horizontal ducts and 100 feet for vertical risers.
- D. Each section shall be tested at the duct pressure classification. Total allowable leakage should not exceed 2% of the total CFM design for that section being tested.
- E. Contractor shall conduct leakage test on ductwork and the Test and Balance Agency shall witness and certify all tests. Tests shall be performed prior to installing ductwork insulation.
- F. Pressure test all medium pressure ductwork (pressure class of 3" and higher) prior to installation of insulation.
- G. Pressure test all ductwork starting at fan discharge, to inlet of air terminal units.
- H. Pressure test all ductwork concealed in shafts or rated enclosures regardless of pressure class.
- I. Pressure test all ductwork, supply, return, exhaust, and outside air, regardless of pressure class, that are associated with the smoke control system.
- J. Systems shall be inspected and tested to positive pressures, in accordance with the following:
 - 1. There are no visible HVAC defects.
 - 2. There is no audible leakage at any point when area ambient noise is at normal-occupancy level.
- K. Leak Tests: Test apparatus and procedures shall be similar in all respects to those defined in AABC standards. Filtered blower inlet and automatic safety relief device shall be provided to protect system.
- L. Complete testing after the installation of all tapoffs, fire dampers, motorized dampers, access doors, etc., but before installation of terminal air devices. Provide temporary blankoffs at all takeoffs. Complete the testing before shaft is closed up.
- M. If leakage exceeds allowable limits correct the deficiency in ductwork and retest the system until leakage is within acceptable limits.

3.6 DETAILED REQUIREMENTS

- A. Furnish Typewritten Data for all Fans Tabulating:
 - 1. Quantity of air in CFM at each air outlet or inlet.
 - 2. Dry and wet bulb temperatures at each thermostat to the nearest 1/10 of 1 degree.
 - 3. Outdoor dry and wet bulb temperatures, wind direction and velocity, and barometric pressure at the time tests are conducted.
 - 4. RPM of fan or blower.
 - 5. RPM of motor.
 - 6. Ampere input of each motor (one reading on each leg if three (3) phase).
 - 7. No load Amperage and brake horsepower calculations on all motors 1/2 horsepower or larger.
 - 8. Static pressure in inches water gauge at inlet of fan or blower.

9. Duct traverse data.

- B. Furnish Typewritten Data for the Coils Tabulating:
1. Entering and leaving water temperature.
 2. Quantity of air in CFM.
 3. Face velocity in FPM.
 4. Dry and wet bulb air temperature entering and leaving coil.
 5. Capacity of coil in BTUH.
 6. Quantity of water circulated through coil in GPM.

3.7 REPORT

- A. Provide a General Information Sheet Listing:
1. Instruments used and most recent calibration date.
 2. Method of balancing.
 3. Altitude correction.
 4. Manufacturer's performance data for all air devices used.
- B. The Test and Balance Agency shall prepare and submit six (6) copies of the Test and Balance Analysis Report within ten (10) working days of completion.
- C. Report to Contain , at Minimum, the Following:
1. Project cover sheet.
 2. Project summary/general comments.
 3. Log, data and reference records.
 4. Calibration certificates for all test equipment used on project including model and serial number.
 5. Drawings. The Air Balance Agency shall prepare a complete set of full scale drawings showing actual duct runs and outlet/inlet locations. Drawings shall be keyed to and furnished with the Air Balance Report. The HVAC plans are not acceptable for this purpose. Drawings shall be in Auto Cad Latest Version or as approved by the Owner's Representative.
 6. AABC National performance guaranty.

3.8 ACCEPTANCE TEST OF HVAC SYSTEMS

- A. Perform at least two (2) operational tests of the entire HVAC system.
- B. Give each element of the system an operating test of not less than 48 hours' duration to demonstrate to the satisfaction of the Owner that the control system is functioning properly and that the system is capable of producing the required environmental conditions. During this test, operate the system entirely on automatic control and take periodic readings of the inside and outside wet and dry bulb temperatures. Obtain wet and dry bulb temperatures with a recording thermometer-hygrometer. Conduct tests with outside temperature and humidity conditions as near design conditions as practical.
- C. Notify Owner seven (7) days in advance of proposed tests.
- D. Record temperature and humidity at an exterior and interior location for each system as designated by the Engineer at least once every hour, for 48 hours during tests.
- E. Submit a Report Detailing the Following:
1. Instrument used:
 - a. Most recent calibration date
 2. Date of tests.

3. Description of test apparatus locations and methods.
4. Results of tests.
5. Any abnormal usage of the building or abnormal system characteristics observed during the course of the test.

F. Duct Leakage Tests:

1. Seal all openings in duct section to be tested.
2. Connect test apparatus to test section of duct using a flexible duct connection or hose.
3. Close damper or blower suction side to prevent excessive build up of pressure.
4. Start blower and gradually open damper on suction side of blower.
5. Build up pressure in duct test section between air handling unit and air terminal units to the level of the duct pressure classification.
6. Read the flow meter and compare the leakage in cfm per square foot with the allowable rate. If it meets the allowable rate, proceed to step (11). If it does not meet the allowable rate, follow steps (8), (9), (10) and (11).
7. Inspect the pressurized duct for all sensible leaks. Mark location of each leak.
8. Depressurize and repair all visual and audible leaks.
9. Upon completion of repairs, retest until leakage rate is acceptable.
10. Complete test report on air leakage test summary form. Remove temporary blankouts and seals.
11. Each tested duct section shall be certified by the field test inspector. Provide a certified report at the end of the project. At a minimum, the report shall include a certification letter certifying that all the tested sections have met the requirement, test data, results, and tested dated, technician name(s) that performed the tests, and drawings indicating the test sections.

3.9 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

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 RELATED DOCUMENTS

- A. General Conditions and Supplementary Conditions apply to this Section.

1.3 WORK INCLUDED

- A. Insulation for piping, ductwork and equipment.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Not applicable.

1.5 WORK TO BE FURNISHED BUT PROVIDED BY OTHERS

- A. Not applicable.

1.6 ALTERNATES

- A. Supply branch duct may be lined similar to main supply duct as indicated on plans.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

- C. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.8 SUBMITTALS

- A. The following shall be submitted for review and approval:
 - 1. Insulation
 - 2. Adhesive
 - 3. Jacket and Covers
- B. All submittals shall be in conformance with section 23.

1.9 DELIVERY, STORAGE AND HANDLING

- A. All insulating material shall be stored in a dry atmosphere and delivered to the job site in like manner.
- B. See Section 23.

1.10 WARRANTIES

- A. See General Conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are approved:
 - 1. Insulation: Manville, Owens Corning, Certainteed, Knauf, Armstrong
 - 2. Adhesives: Foster, 3M, Armstrong, Manville, Childers
 - 3. Jackets/Covers: Childers, Knauf, Manville

2.2 INSULATION

- A. General: Furnish all materials and cover all ductwork, piping and equipment as hereinafter specified.
- B. Pipe Insulation:
 - 1. Refrigerant Piping Insulation:
 - a. All refrigerant suction line above grade shall be insulated with 1.0" thick flexible foamed plastic tubing, IMCOA insulation, IMCOLOCK or IMCOSHIELD, or approved equal. Insulation exposed to view shall be covered with pre-molded PVC jacketing by Zeston, or equal.

2. Condensate Drain Piping: Insulate all air conditioning coil drains exposed in conditioned areas and concealed in furred spaces on above ceiling as specified herein for fittings, flanges and valves, except thickness to be 1 inch for all pipe sizes.
 - a. Flexible foamed plastic tubing insulation, IMCOA insulation, IMCOLOCK or IMCOSHIELD or approved equal, may be used for copper tubing runs. Thickness should be 1/2 inch.
3. No insulation shall be applied until lines have been tested. Partial testing of lines will be permitted to expedite the insulating, if required, as directed by the Owner's inspector. All insulation is to be applied over clean dry pipe.
4. All insulated pipes and fittings exposed to weather shall be covered by Childers aluminum rolled jacketing, 0.16 gage and 3/16" unless the manufacturer of the insulation warrants its product against outdoor exposure such as IMCOA insulation, IMCOLOCK or IMCOSHIELD.
5. The minimum pipe insulation R-value shall be (uno) per 2019 CEC standards table 120.3-A.

C. Duct Insulation:

1. Minimum R-value of duct insulation shall be per 2019 CEC Section 120.4.
2. All exposed air conditioning and heating supply and return ducts shall be insulated on the outside with 2 inch minimum thickness, R-8.0 3/4 lb. density, J-M Microlite duct insulation, or approved equal.
 - a. The insulation shall be wrapped entirely around the duct with all joints lapped at least 2 inches and secured with 16 gauge galvanized wire on 12 inch centers. The insulation shall cover all surfaces including standing seams.
 - b. In exposed areas, apply 8 oz. canvas and finish with a heavy, smooth coat of insulation coating, Foster 30-36 or approved equal.
3. Duct Lining: All ducts, where shown on the drawings, all supply, return and exhaust ducts located within twenty (20) linear feet in every direction of any fan, all exposed supply duct in conditioned area, all plenum chambers shall be lined with 1 inch thickness (R-4.3) J.M. Lina-Coustic or approved equal and all conditioned supply and return ductwork exposed to weather per CEC Section 124 (a), shall be lined with 2 inches minimum thickness (R-8.0), J-M Lina-Coustic or approved equal with flame spread rating of 25. The duct liner shall have an air friction correction factor not greater than 1.1 at a velocity of 3000 fpm.
 - a. The duct liner shall be applied with 100% coverage of 3M #37 or #38 fire resistant adhesive. On horizontal runs, tops of ducts over 12 inches in width and/or sizes 16 inches in height shall be additionally secured with mechanical fasteners on a maximum of 15 inch centers. On vertical runs, mechanical fasteners shall be spaced on a maximum of 15 inch centers on all width dimensions over 12 inches. Fasteners shall start within 2 inches of the leading edge of all cross joints within the duct section. Mechanical fasteners shall be flush with the liner surface. All exposed edges and the leading edge of all cross joints of the liner shall be heavily coated with an approved fire-resistant adhesive.
 - b. All ductwork dimensions shown on the plans are net dimensions including sheet metal dimension.
4. All ducts exposed to the weather shall be weather-proofed with Duro-Dyne Mastic over joints and fasteners.
5. All air conditioning supply and return ducts exposed to the weather shall be internally insulated with 2" thick R-8.0 duct liner insulation, as hereinbefore specified.

6. Lined duct work need not be externally insulated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches . Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches .
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches .
1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.

3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- C. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 2. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 3. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - a. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.

3.7 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. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
 - 4. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC

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.
- B. OPR, BOD, and BOD-HVAC documentation prepared by Owner and Architect contains requirements that apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipments.

1.3 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.
- B. BoD: Basis of Design.
- C. BoD-HVAC: HVAC systems basis of design.
- D. CxA: Commissioning Authority.
- E. OPR: Owner's Project Requirements.
- F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- G. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor:
 - 1. Attend procedures meeting for TAB Work.
 - 2. Certify that TAB Work is complete.
- B. Mechanical Contractor:
 - 1. Attend TAB verification testing.
 - 2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

- C. HVAC Instrumentation and Control Subcontractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.
- D. TAB Contractor:
 - 1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
 - a. Verify the following:
 - 1) Accessibility of equipment and components required for TAB Work.
 - 2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
 - 3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
 - 4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
 - 5) Air and water flow rates have been specified and compared to central equipment output capacities.
 - b. Identify discontinuities and omissions in the Contract Documents.
 - c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
 - 2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" and
- E. Electrical Subcontractor:
 - 1. With the Mechanical Subcontractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
 - 2. Attend TAB verification testing.

1.5 COMMISSIONING DOCUMENTATION

- A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."
- B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
- C. Test Checklists: CxA with assistance of Architect shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:
 - 1. Calibration of sensors and sensor function.
 - 2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
 - 3. Control sequences for HVAC systems.
 - 4. Strength of control signal for each set point at specified conditions.
 - 5. Responses to control signals at specified conditions.
 - 6. Sequence of response to control signals at specified conditions.

7. Electrical demand or power input at specified conditions.
8. Power quality and related measurements.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
11. Interaction of auxiliary equipment.
12. Issues log.

1.6 SUBMITTALS

- A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."
- B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.
- C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.
- D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
- E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.
- F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.
- G. Corrective Action Documents: CxA shall submit corrective action documents.
- H. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Prerequisites for Testing:
 1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
 2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
 3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
 5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
 6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
 7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
 8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
 9. Annotate checklist or data sheet when a deficiency is observed.
 10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
 - a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
 - b. Operation of terminal units in both heating and cooling cycles.
 - c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
 - d. Building pressurization.
 - e. Total exhaust airflow and total outdoor-air intake.
 - f. Operation of indoor-air-quality monitoring systems.
 11. Verify proper responses of monitoring and control system controllers and sensors to include the following:
 - a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
 - b. Report deficiencies and prepare an issues log entry.
 12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.
- B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:
1. Occupied and unoccupied.
 2. Warm up and cool down.
 3. Economizer cycle.
 4. Emergency power supply.
 5. Life-safety and safety systems.
 6. Smoke control.
 7. Fire safety.
 8. Stair pressurization system.
 9. Partial occupancy conditions.
 10. Special cycles.

3.2 TAB VERIFICATION

- A. TAB Contractor shall coordinate with CxA for work required in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" TAB Contractor shall copy CxA with required reports, sample forms, checklists, and certificates.
- B. Each Contractor, HVAC Subcontractor, and CxA shall witness TAB Work.
- C. TAB Preparation:
 - a. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
 - b. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.
- D. Ductwork Air Leakage Testing:
 - 1. Architect will identify, for HVAC Subcontractor and CxA, portions of duct systems to have ductwork air leakage testing. Ductwork air leakage testing shall be performed according to Division 23 Section "Metal Ducts," and shall be witnessed by the CxA.
 - 2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC Contractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.
- E. Verification of Final TAB Report:
 - 1. CxA shall select, at random, 10 percent of report for field verification.
 - 2. CxA shall notify Contractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item is defined as follows:
 - a. For all readings other than sound, a deviation of more than 10 percent.
 - 1) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)
 - 4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.
- F. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.
- G. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

- A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.
- B. Perform tests using design conditions whenever possible.
 - 1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from

- CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
 3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.
- C. Scope of HVAC Contractor Testing:
1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
 2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Subcontractor, and HVAC Instrumentation and Control Subcontractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.
- E. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. CxA shall review and comment on submittals, test data, inspector record, and boiler certification and shall compile information for inclusion in systems manual.
- F. HVAC Instrumentation and Control System Testing:
1. Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation for HVAC Controls" The CxA, HVAC Contractor and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.
 2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.
- G. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC Contractor shall prepare pipe system cleaning, flushing, and hydrostatic testing. CxA shall review and comment on plan and final reports. CxA shall certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed. Plan shall include the following:
1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 2. Description of equipment for flushing operations.
 3. Minimum flushing water velocity.
 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- H. Energy Supply System Testing: HVAC Subcontractor shall prepare a testing plan to verify performance of hot-water and equipment. Plan shall include the following:
1. Sequence of testing and testing procedures for each equipment item and pipe section to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each

- section of piping to be physically located and identified when referred to in system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
- I. Heat-Generation System Testing: HVAC Subcontractor shall prepare a testing plan to verify performance of boilers, feedwater equipment, and auxiliary equipment. Plan shall include the following:
1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
 2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
- J. Refrigeration System Testing: HVAC Subcontractor shall prepare a testing plan to verify performance of air-handlers, package units, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. Plan shall include the following:
1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
 2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
- K. HVAC Distribution System Testing: HVAC Subcontractor shall prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:
1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
 2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
- L. Vibration and Sound Tests: HVAC Subcontractor shall prepare testing plans to verify performance of vibration isolation and seismic controls. CxA shall witness and certify tests and inspections.
- M. Deferred Testing:
1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
 2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.
- N. Testing Reports:
1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
 2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor, plus comments. Provide space for testing personnel to sign off on each data sheet.
 3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION

SECTION 23 23 00
REFRIGERANT 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. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88M, Type A or B).
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- G. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - 3. Piston: Removable polytetrafluoroethylene seat.
 - 4. Closing Spring: Stainless steel.
 - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 - 8. Working Pressure Rating: 500 psig (3450 kPa).
 - 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- H. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig (3450 kPa).

- I. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
 - 1. Body and Bonnet: Plated steel.
 - 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Threaded.
 - 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24 or 115-V ac coil.
 - 6. Working Pressure Rating: 400 psig (2760 kPa).
 - 7. Maximum Operating Temperature: 240 deg F (116 deg C).
 - 8. Manual operator.

- J. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - 1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 - 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 3. Seat Disc: Polytetrafluoroethylene.
 - 4. End Connections: Threaded.
 - 5. Working Pressure Rating: 400 psig (2760 kPa).
 - 6. Maximum Operating Temperature: 240 deg F (116 deg C).

- K. Thermostatic Expansion Valves: Comply with ARI 750.
 - 1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 3. Packing and Gaskets: Non-asbestos.
 - 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 - 5. Suction Temperature: 40 deg F (4.4 deg C)
 - 6. Superheat: Adjustable.
 - 7. Reverse-flow option (for heat-pump applications).
 - 8. End Connections: Socket, flare, or threaded union.
 - 9. Working Pressure Rating: 700 psig (4820 kPa).

- L. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
 - 1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 3. Packing and Gaskets: Non-asbestos.
 - 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - 5. Seat: Polytetrafluoroethylene.
 - 6. Equalizer: External.
 - 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
 - 8. End Connections: Socket.
 - 9. Set Pressure: Jamet.
 - 10. Throttling Range: Maximum 5 psig (34 kPa).
 - 11. Working Pressure Rating: 500 psig (3450 kPa).
 - 12. Maximum Operating Temperature: 240 deg F (116 deg C).

- M. Straight-Type Strainers:
 - 1. Body: Welded steel with corrosion-resistant coating.
 - 2. Screen: 100-mesh stainless steel.
 - 3. End Connections: Socket or flare.
 - 4. Working Pressure Rating: 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 275 deg F (135 deg C).

- N. Angle-Type Strainers:
 - 1. Body: Forged brass or cast bronze.
 - 2. Drain Plug: Brass hex plug.

3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3450 kPa).
 6. Maximum Operating Temperature: 275 deg F (135 deg C).
- O. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- P. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated charcoal.
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig (14 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 240 deg F (116 deg C).
- Q. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated charcoal
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig (14 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 240 deg F (116 deg C).
- R. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or flare.
 3. Working Pressure Rating: 500 psig (3450 kPa).
 4. Maximum Operating Temperature: 275 deg F (135 deg C).
- S. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 2. Comply with UL 207; listed and labeled by an NRTL.
 3. Body: Welded steel with corrosion-resistant coating.
 4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
 5. End Connections: Socket or threaded.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 275 deg F (135 deg C).
- T. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.2 REFRIGERANTS

- 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. Atofina Chemicals, Inc.
 2. DuPont Company; Fluorochemicals Div.
 3. Honeywell, Inc.; Genetron Refrigerants.
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 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 to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Section 23 09 00 "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 1. Shot blast the interior of piping.
 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- R. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- S. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- T. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- U. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- V. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- W. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - 2. Spring Hangers to support vertical runs.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.5 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 4. Charge system with a new filter-dryer core in charging line.

3.6 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 30 00

HVAC AIR DISTRIBUTION

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: Provide ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.
- B. Related Sections:
 - 1. Section 23 07 00: HVAC Insulation.
 - 2. Section 23 81 00: Decentralized Unitary HVAC Equipment.

1.3 SUBMITTALS

- A. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements (including allowances for servicing) and other data necessary to ensure compliance with requirements of these Specifications and performances indicated on Drawings. Data shall also include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.
 - 4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and ARI Standards (ASHRAE Standard 70 for air inlets and outlets; ASHRAE Standard 130 and ANSI Standard 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the Architect for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
 - 5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.

6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts
 - b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
 - c. Typical details of supports for equipment and ductwork.

1.4 QUALITY ASSURANCE

- A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23.
- B. All sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ASHRAE Standards 70, 130 and ARI Standard 880. Equivalent test and calculation procedures may be substituted for the above procedures if approved in advance by the Architect.

1.5 PRODUCT HANDLING

1. Protection, Replacements, Delivery and Storage: Comply with provisions stated in Section 23.

1.6 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless otherwise noted, provisions, including amendments thereto, of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this section.
- B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the HVAC Duct Construction Standards of SMACNA.
- C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
- D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.
- E. Galvanized steel ducts gage thickness and permissible joints and seams of concealed ductwork shall conform to requirements in HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code

(CMC) unless noted otherwise on the drawings. The more stringent requirements shall prevail. Galvanized steel ducts gage thickness and permissible joints and seams of exposed ductwork shall conform to requirements in Tables 2 and 3, Minimum Metal Gages, of this section. When more stringent requirements are noted on the drawings the most stringent requirement shall prevail.

- F. Button punch snap-lock seams, Lockformer, or equal, shall be permitted only in concealed areas using 20 & 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- G. Ducts shall be reinforced in accordance with SMACNA standards: Cross-broken Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-broken. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.
- H. Round and Oval Galvanized Steel and Aluminum Ducts:
 - 1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Ducts and fittings shall be as manufactured by United Sheet Metal, or equal. Provide gages of ducts and fittings recommended by manufacturer.
 - 2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
 - 3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
 - 4. Minimum duct wall thickness for concealed flat oval duct construction shall conform to requirements in HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC). The more stringent requirements shall prevail. Gage thickness and permissible joints and seams of exposed ductwork shall conform to requirements in Table 1, of this section.
 - 5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.
- I. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etc., shall conform to applicable provisions of this section or SMACNA manual.
- J. L. Duct Seam and Joint Sealant: Provide sealant or tape for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar taps, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.
 - 1. Sealant for low-pressure ducts shall be: Design Polymerics- DP1010 or 1020, Childers Chil-Flex CP145A/146, Foster's Duct-Fas 32-19, Kingco-Glenkote11-500, Ductmate ProSeal or FiberSeal, or equal. Provide tape joints with canvas fastened with Borden Chemical Division Arabol adhesive, or equal.
 - 2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
 - 3. Sealant materials shall comply with the flame spread/smoke developed rating of current CMC when tested in accordance with ASTM E84.
 - 4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 @ 2000 hours QUV.

K. Restrictions:

1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.
2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

L. Flexible Ducts

1. Flexible duct shall be aluminum, insulated for conditioned air supply and return. The flexible ducts shall be Casco No.2PMJfactory fabricated with exterior reinforced laminated vapor barrier, 2 inch thick fiber glass insulation (K=0.125, R8.0 @ 75 degrees F.), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90 A or 90 B and tested in accordance with UL Standard, UL-181. Non-insulated metallic ducts shall be provided for exhaust only.
2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.

2.2 ACOUSTICAL DUCT AND PLENUM LINERS

- A. Refer to specification section 23 07 00, 2.2C.3.

2.3 DAMPERS

A. Manually Operated Volume Control Dampers:

1. Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD 35, or equal.
2. Round: Frame shall be constructed of not less than 16 gage galvanized steel, blades of not less than 16 gage galvanized steel channel construction with factory neoprene seals, 1/2 inch diameter axle shafts and locking hand quadrant. Ruskin CDR S25, or equal.
3. Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than 1/2 inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO 25, or equal.

B. Motorized Volume Control Dampers:

1. Rectangular: Multi-blade type opposed blade operation, 16-gage minimum steel channel frame construction; 16-gage galvanized steel blades center pivoted on 1/2 inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching 2-position motorized actuator with linkages, 120 VAC by Barber-Colman, Honeywell, or equal. Ruskin, Damer CD35, or Pottorff.

2. Round: Butterfly type constructed with minimum 18 gage galvanized steel frame with steel angle reinforcement on above 20 inches diameter. Blade 2-layer, minimum 14-gage equivalent thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching 2-position motorized actuator with linkage 120 VAC by Barber-Colman, Honeywell, or equal.
3. Electronic Damper Actuators: Belimo F Series, Honeywell, Invensys.
 - a. Sized for torque required for damper seal at load conditions.
 - b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
 - c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 - d. Power Requirements: As indicated on Drawings.
 - e. Actuator Timing: Shall meet 15 seconds.
 - f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.
 - g. Auxiliary Switches: Provide as indicated in the Drawings for signaling, fan control and/or position indications.

C. Automatic Fire Dampers:

1. Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NBFU Pamphlet 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gauge at 2000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by manufacturer. Dampers shall be rated for 1-1/2 hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff Model VFD-10 ISB (CSFM No. 3225-368:101), Ruskin, or equal.
 - b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff Model CFD-15 ES (CFSM No. 3225-368:104), Ruskin, or equal.
 - c. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1-1/2 hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff Model FSD142 (CSFM No. 3225-368:110) with non-stall motor, or Ruskin Model FSD 35, FSD60 (CSFM No. 3225-245:005, 102) with electric fuse link Model EFL 200, with electric non-stall motor, or equal.

2. Electronic Damper Actuators: Refer to Article 2.04, B, 3.
- D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counterweights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01" within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Pottorff, Ruskin or Metal Form.
- E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gauge static pressure.

2.4 AIR DISTRIBUTION DEVICES

- A. General:
 1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
 2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
 3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:
 - a. Administrative office area: NC 30
 - b. Classrooms: NC 20
 - c. Libraries and other noise sensitive areas: NC 25
 - d. Gymnasiums, cafeterias, lockers areas: NC 30.
 4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings
 5. Ceiling diffusers shall be provided with equalizing grids.
 6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
 7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09900: Paints and Coatings.
 8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
 9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.
- B. Ceiling Diffusers – Refer to specifications section 23 37 13, 2.2.:

C. Grilles – Return and Exhaust Grilles and Registers, Ceiling, Square, Rectangular:

1. Refer to specification section 23 37 13, 2.3.

D. Registers, Supply, Return, Wall:

1. Refer to specification section 23 37 13, 2.4.

2.5 SOUND ATTENUATING EQUIPMENT - DUCT SILENCERS

A. Provide factory fabricated duct silencers of tubular or rectangular type, for high or low velocity service, with arrangements, sizes and capacities as indicated on Drawings. Construct silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gauge between inside and outside of unit, and stiffen or brace as required to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Filler material shall comply with the following:

1. Fire Safety Standards: NFPA 90A & B
2. Temperature: ASTM C411
3. Airvelocity: ASTM C1071, UL 181
4. Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255
5. Corrosion Resistance: ASTM C739, C665
6. Fungi Resistance: ASTM G21
7. Water Vapor Sorption: ASTM C1104, less than 1% by weight
8. Formaldehyde, Phenolic Resins or other Volatile Organic compounds: 0%

B. Select and provide silencers from acoustical and aerodynamic rating tables based on actual test readings or interpolated values of such readings obtained from tests made by recognized independent laboratories. Tests shall be in accordance with ASTM E477.

C. Select and provide silencers for air pressure drops not exceeding those indicated on Drawings, and of types, sizes and models for which noise reduction values, dynamic insertion loss, in decibels reference 10-12 watts, are not less than indicated on Drawings.

2.6 ZONE TEMPERATURE CONTROL DEVICES

A. Variable Air Volume Control Terminals

1. VVT: ARI 880 certified, single duct, pressure independent, variable air volume control terminal with reheat coil, sound attenuators, multi-point flow sensor, electric actuators and electronic direct digital controls. The controllers shall comply with Section 23. The coils shall be copper tubes with copper fins. Casings shall be 22 gage galvanized steel lined with minimum ½", 1.5 lb density, foil faced insulation that complies with NFPA 90A and UL 181.
2. York, Carrier, and Trane.

2.7 SMOKE DETECTORS

A. Refer to Division 16: Fire Alarm Systems.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.
- C. Duct dimensions indicated are net inside dimensions. If the indicated duct is to be furnished with an acoustic lining, add twice the thickness of the acoustic liner in both the duct width and height dimensions to provide the gross sheet metal duct dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.
- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.
- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 07 00: HVAC Insulation.
 - 1. Ducts exposed to weather shall be furnished with exterior insulation with weather jacket or interior lining as indicated on Table 2, Section 23 07 00: HVAC Insulation.
- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint, Devcon Z or ZRC cold galvanizing compound.

3.3 DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of concealed ductwork shall conform to SMACNA and CMC. Exposed ductwork shall conform to the following tables in addition to SMACNA and CMC. The most stringent standards shall prevail. Hoods, plenums, and castings shall not be lighter than the duct gage listed in Table 2 for corresponding dimensions. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Provide longitudinal seams of the grooved snap lock and standing, sealed and taped, or sealed spiral or continuously welded. For exhaust duct, taping may be omitted.

TABLE 1 - SHEET METAL THICKNESS FOR CIRCULAR DUCTS AND FLAT-OVAL (FOR STATIC PRESSURES LISTED)

Gage Thickness			
2" Water Column Maximum S.P. Round / Oval	Diameter of Duct Maximum Diameter Support	Horizontal Girth Maximum Distance	Joints
26 / 24	Up to 9"	10'	2" slip
26 / 24	9" - 14"	8'	4"
24 / 22	14" - 23"	8'	4"
22 / 20	23" - 37"	8'	4"
20 / 18	37" - 51"	6'	1-1/4"x1-1/8" flange

- C. Construction Details for Rectangular Sheet Metal Ducts for Low-Pressure Systems - Velocities not Exceeding 2,000 Feet Per Minute:
 - 1. For pressures in excess of 2 inches water column, duct wall thickness shall be 2 gages heavier than set forth in this table.
 - 2. Duct specifications shown below are applicable when ducts larger than 18 inches are cross-broken. Where cross breaking is not provided, duct wall thickness shall be 2 gages heavier on ducts 19 inches to 60 inches wide unless longitudinal standing seams are furnished.

TABLE 2 - MINIMUM METAL GAGES - UNREINFORCED RECTANGULAR DUCT
(2" W.G. OR LESS)

Minimum Gage Thickness Steel / Aluminum	Max. Side, Gross Dimensions	Duct Permissible Girth Joints	Horizontal Support Maximum Distance
26 / 24	Up to 10"	Drive-slip, plain S-slip, or 1" government lock	10'
24 / 22	11" – 12"	Drive-slip, plain S-slip, or 1" government lock	10'
22 / 20	13" – 14"	Drive-slip, plain S-slip, or 1" government lock	10'
20 / 18	15" – 18"	Drive-slip, plain S-slip, or 1" government lock	10'
18 / NA	19" – 20"	Drive-slip, plain S-slip, or 1" government lock	10'
16 / NA	21" – 24"	Drive-slip, plain S-slip, or 1" government lock	10'

**TABLE 3 - MINIMUM METAL GAGES - REINFORCED RECTANGULAR DUCT
(2" W.G. OR LESS)**

Reinforcement Ratings to Comply with SMACNA Standards			
Minimum Gage Thickness Steel / Aluminum	Max. Side, Gross Dimensions	Duct Permissible Girth Joints	Reinforcement Spacing Max. Distance
26 / 24	Up to 14"	Drive-slip, plain S-slip, or 1" government lock with B rated reinforcement	6'
24 / 22	13" - 18"	Drive-slip, plain S-slip, w/ C rated reinforcement	8'
	19" - 30"	Standing S/D -slip, 1" bar slip, or 1" government lock with E rated reinforcement	5'
22 / 20	31" - 36"	1" bar slip, reinforced bar slip, or 1" government lock w/ F rated reinforcement	5'
	37" - 48"	1 5/8" standing S or 1" government lock w/ G rated reinforcement	4'
20 / 18	49" - 54"	1 5/8" standing S or 1" government lock w/ H rated reinforcement or G rated tie rods	4'
18 / NA	55" - 84"	1 5/8" standing S or 1" government lock w/ I rated reinforcement or G rated tie rods	4'
	85" - 108"	2 1/2" standing seam w/ K rated reinforcement or H rated tie rods	4'

* Button punch snap-lock seams, Lockformer, or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.

- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.
- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint, Devcon Z or ZRC cold galvanizing compound.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint, Devcon Z or ZRC cold galvanizing compound.

3.4 DUCTS AND PLENUMS WITH LINERS

- A. Ducts and plenums lined with acoustical insulation shall be as indicated on Drawings.
- B. Duct dimensions indicated on Drawings are net. Add thickness of acoustic liners to obtain gross sheet metal duct dimensions.
- C. For duct liner Specifications and installation, refer to Section 23 07 00: HVAC Insulation.

3.5 DUCT ELBOWS AND TURNING VANES

- A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.
- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall be thick double-wall vane type, Titus Y or Z, Tuttle and Bailey Ducturn, or equal. Duro-Dyne vane rail system duct turns may be furnished, provided they are of thick double wall type and Shop Drawings are submitted and reviewed by the Architect. Duct turning vanes shall be of same material as ductwork and shall be rigidly fastened in ductwork.

3.6 DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, taped or welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws and taped.
- B. Other ducts shall be furnished with joints and seams sealed by caulking, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.

- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Unless otherwise detailed, duct shall be sealed with approved duct sealer or Arabol and canvas tape. Ducts shall not be covered or insulated on outside until joints are inspected by the IOR. A second coat of sealant or Arabol shall be installed 24 hours after initial application if separation occurs. Provide only approved and UL or Factory Mutual listed material for sealing and caulking.
- F. Seams around fan, coil housing and plenums shall be sealed with gaskets or caulking compound to provide an airtight assembly.
- G. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with caulking or sealing compound shall be used only at fan and fume hood connections.
- H. Alternative duct connectors such as Ductmate® or Mez® may be used if the following conditions are met:
 1. One of the specifically listed connectors is submitted and approved by the Architect.
 2. The correct size connector, application, and gage of material conform to SMACNA Standards.
 3. The connector is installed per manufacturer's specifications.

3.7 DUCT TRANSITION

- A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the Architect.

3.8 DUCT TEST HOLES

- A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.9 SOUND ATTENUATING EQUIPMENT

- A. Install sound attenuators where required and indicated on Drawings. Refer to manufacturer's instructions for required installation.

3.10 FLEXIBLE CONNECTIONS

- A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duralon by Duro-Dyne Corporation, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet

openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.11 AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.
- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted
- C. Registers and Grilles: diffusers to duct collars.
 - 1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.
 - 2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
 - 3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.12 DAMPERS

- A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.
 - 1. Provide and install manual volume dampers per current SMACNA standards to allow balancing per current AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
 - 2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where 2 or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
 - 3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
 - 4. Do not provide opposed blade dampers at air inlets and outlets.
 - 5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet/inlets. An acoustic flexible duct should be provided between the outlet/inlet and the damper for concealed ducts.
 - 6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventlock, Duro-Dyne, or equal.
 - 7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels

- are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventlock, Young, or equal.
8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.
 9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23.
 10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the Architect.
 11. Dampers shall not be installed in combustion air ducts.
 12. Access panels shall be installed for access at each damper's operating mechanism.

3.13 FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and U.L. 555S classified for 1-1/2 hours.
- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.14 SMOKE DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the Uniform Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that exception 1 to CMC 609 regarding automatic shut down of systems with total coverage smoke detection systems is applied.
- C. Smoke detectors shall be installed in supply system downstream of filters.

3.15 BACKDRAFT DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Energy Conservation Standards, Title 24, CCR.

3.16 DUCT SLEEVES AND PREPARED OPENINGS

- A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.
- B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.
- C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.
- D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.
- E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.17 FLEXIBLE DUCT RUNOUTS

- A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA No. 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.18 DUCT HANGERS AND SUPPORTS

- A. Exposed or easily accessible ductwork: Single horizontal ducts shall be suspended from heavy steel hanger straps securely fastened to overhead structural members. Ducts shall be supported by a hanger strap passing around and fastened to duct with not less than 2 Parker No. 10 screws set approximately 2 inches in from each edge, to form a supporting stirrup attached to overhead supports. Rectangular ducts shall be provided with 2 hanger straps, one located on each side of duct. Round ducts may be installed from a single hanger strap unless conditions require that duct be held tight against ceiling, in which case 2 hanger straps may be brought down each side of duct, oriented at right angles to axis of duct and securely fastened to duct standing leg seam or angle iron stiffener with a minimum of 2 bolts, measuring 1/4 inch, for each side of duct. Hanger straps shall be galvanized with a minimum size of 1-1/8 inches x 14 gage. Angles of galvanized steel of 1-1/8 inches x 1-1/8 inches x 16 gage (14 gage for ducts 60 inches or greater) may be furnished instead of straps.

- B. Non-accessible ductwork: Non exposed and hidden from sight during regular operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.
- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1-1/2 inches x 1-1/2 inches x 1/8 inch for duct sizes through 60 inches in greatest dimension, 2 inches x 2 inches x 1/8 inch for duct sizes 61 inches through 84 inches, 2 inches x 2 inches x 3/16 inch for duct sizes 85 inches through 96 inches, and 2 inches x 2 inches x 1/4 inch for duct sizes over 97 inches
- D. Ducts 30 inches square area and greater and ducts 20 feet long and longer shall be seismically restrained. Refer to Section 23 05 08: Vibration and Seismic for HVAC Piping and Equipment.
- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.19 ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12 inches x 12 inches in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24 inches x 24 inches, unless otherwise detailed. Two or more valves shall not be located in same access area unless sufficient clearance is provided for operation, servicing and removal of each valve.
- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8 inches x 8 inches and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Approved serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise

specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.

- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
- G. Access panels shall be fire-rated Milcor manufactured by Inland Steel Products Co., or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with 2 keys each, instead of Allen headlock for non-rated ceilings.
- H. Access panels that are part of an integrated ceiling are specified in Section 09 50 10: Acoustical Ceilings. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.
- I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
- J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
- K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
- L. Letter words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.
- M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed 5 keys for any one Project.
- N. Access plates and panels shall be furnished with manufacturer's name or trademark and model number cast or stamped thereon, or upon a label permanently affixed thereon.
- O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
- P. Refer to SMACNA Figures 2-10 and 2-11 for access plate and door construction.

3.20 PRESSURE TESTING

- A. Test all supply, return and exhaust ducts, plenums and casings at static pressure indicated for system to insure substantially airtight ducts per current industry standards before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean that no air leakage is noticeable through senses of feeling or hearing at duct joints. Test ductwork for leaks at 1-1/2 times operating pressure but at a minimum of 2 inches of water.

3.21 CLEANUP

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

3.22 PROTECTION

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

END OF SECTION

SECTION 23 31 13

DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide and install ductwork and accessories complete for the air distribution system, as indicated on the drawings and as specified.

1.2 STANDARDS

- A. Comply with SMACNA (Sheet Metal and Air Conditioning Contractors National Association) recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.
- B. Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), except as otherwise indicated.
- C. Comply with the National Standards Manual of the American Air Balance Council (AABC) for testing of duct systems.
- D. Use of proprietary manufacturers' tables for selection of duct gauges is not acceptable (e.g. "Ductmate", 'TDC').

1.3 SUBMITTALS

- A. Refer to Division 01 and Section 230500 BASIC HVAC REQUIREMENTS, MATERIALS AND METHODS.
- B. Submit manufacturer's product data and/or shop drawings for the following:
 - 1. Transition elbows.
 - 2. Seal and reinforcing schedule for all ductwork fabrication types.
 - 3. Turning vane and turning vane installation.
 - 4. Ductwork layouts and fabrication drawings.
 - 5. Detailed drawings of fume hood exhaust plenums including fan connections, supports and bracings.
 - 6. Standards.
 - 7. Hangers and Supports.
 - 8. Duct lining.
 - 9. Duct lining adhesive.
 - 10. Sealants.
 - 11. Manual volume dampers.
 - 12. Fire dampers.
 - 13. Combination fire and smoke dampers.
 - 14. Smoke dampers.
 - 15. Automatic control dampers.
 - 16. Sound attenuators.

17. Access doors.
 18. Duct air monitoring stations.
- C. Duct Pressure Leak Test:
1. Procedures, including testing pressure.
 2. Certifications.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

- A. Ducts shall be constructed with G-90 or better galvanized steel (ASTM A 653) LFQ, chemical treat, unless otherwise noted.

2.2 RECTANGULAR DUCT

- A. Construct rectangular ductwork to meet criteria defined in the SMACNA "HVAC Duct Construction Standards Metal and Flexible" latest edition and latest CMC (where SMACNA and CMC requirements differ, SMACNA DCS requirements shall govern). All ductwork must comply with all local, state and federal code requirements.
- B. Where the standards allow the option of external reinforcing or internal tie rods, only the external reinforcing options shall be used.
- C. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
- D. Ductmate, TDC or similar proprietary duct connection systems will not be accepted, except as a method of joinery.
- E. Fittings shall be constructed and reinforced as ductwork according to the longest span.

2.3 ROUND AND OVAL DUCT

- A. Round and oval duct shall be galvanized steel, constructed in accordance with SMACNA "Duct Construction Standards (DCS), Metal and Flexible" and the latest CMC (where SMACNA and CMC requirements differ, SMACNA DCS requirements shall govern), except as noted.
- B. Minimum duct gauge shall be 24 gauge.
- C. All round ducts shall be spiral lock seam. Longitudinal seam duct is not acceptable.
- D. Round ductwork shall be spiral seam construction only. Gauges and fittings shall be in accordance with SMACNA Duct Construction Standards and the latest CMC (where SMACNA and CMC requirements differ, SMACNA DCS requirements shall govern), except as noted.
1. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct with screws and sealing compound applied continuously around joint before assembling and after fastening.

2. Joints 21"-72" diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.
 3. Joints 73" diameter and up, use companion angle flanged joints only as defined in Fig. 3-2 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.
- E. Fittings shall be continuously welded, standing seam, or spot welded and sealed. Metal thickness and reinforcing shall be equivalent to the requirements of largest span.
1. All elbows greater than 45" shall be the radius type, $R=1.5$ times duct diameter.
 2. Elbows less than 12" shall be of die stamped construction. Elbows 12" or greater shall be 5-gore construction.
 3. Diverging and converging flow fittings shall be constructed with no excess material projecting from the body into the branch tap entrance. All such fittings shall be 45° "shoe" entrance, wye plus elbow, or 45° lateral branch. Special fittings such as heel tapped elbows and bullhead tees may be used only where shown on drawings. Straight saddle taps shall not be used.

2.4 LOW PRESSURE DUCTWORK

- A. Applicable to supply ductwork downstream of air terminal units, general and toilet exhaust systems, return air ductwork, outside air intake ductwork, and ductwork for fan-coil systems (except fan-coil unit system containing HEPA filters located in duct distribution system).
- B. Gauges, Reinforcement, Joints, Seams, Sealing, Fitting, Support and Other Details: Construct ducts per SMACNA DCS based on the total static pressure plus 1" of the corresponding fan (except supply air fan in air handling unit with system having air terminal units), as scheduled on the drawing.
- C. Sealing: In accordance with SMACNA DCS, Table 1.2.
- D. Ductwork used for transfer air purposes only can be constructed at 1" pressure class.

2.5 MEDIUM PRESSURE DUCTWORK

- A. Applicable to supply ductwork discharge of air handling unit to inlet of air terminal units and to HEPA filter connection and fan pressure above 3" external static pressure.
- B. Gauges, Reinforcement, Joints, Seams, Fitting, Support and Other Details: Construct ducts per SMACNA DCS based on the total static pressure of the corresponding supply fan as scheduled on the drawing. Round ducts, gauge according to SMACNA DCS Table 3-2, with the size converted on the basis of equal pressure drop, may be furnished tin lieu of rectangular ducts shown on the drawings.
- C. Sealing: Class A in accordance with SMACNA DCS, Table 1-2. Refer to Part 3 – EXECUTION for required pressure tests for installed duct systems.
- D. Rectangular Ducts and Casings: In accordance with SMACNA DCS. Submit details of proposed joints/sealing system. Provide bolted construction and tie-rod reinforcement where required.

- E. Round Ducts: Furnish duct and fittings made by the same manufacturer to ensure good fit of slip joints.
 - 1. Elbows: Factory fabricated elbows, stamped or segmented standing seam per SMACNA DCS Figure 3-3. Coat galvanized areas of fittings, damaged by welding with a corrosion-resistant aluminum paint or galvanized repair compound.
 - 2. Provide conical tees, laterals, reducers, and other low loss fittings as shown in SMACNA Standards.

2.6 CONTRACTOR FABRICATED CASINGS AND PLENUMS

- A. Unless required otherwise by drawings, single wall casings and plenums may either be contractor or factory fabricated where shown on drawings. All double wall casings and plenums shall be factory fabricated.
- B. Casings and plenums shall be constructed in accordance with SMACNA "HVAC Duct Construction Standards" and as specified below.
- C. All casings and plenums on the suction side of any fan, including return air, outside air, or mixing plenum shall be constructed to 2" negative pressure class.
- D. Louver blank-off panels shall be constructed to 2" negative pressure class.
- E. All casings and plenums for relief and exhaust air shall be 2" positive or negative pressure class.
- F. All casings and plenums on the discharge side of supply fans shall be 4" positive pressure class.
- G. Single wall plenums shall be of the standing seam type construction. Submit shop drawings indicating overall dimensions, support details, corner & edge details, penetration details, equipment installation details, and pressure class.
- H. Seal all seams, edges, and corners with approved duct sealant.
- I. Casing materials shall be the same as that for the connected duct systems.
- J. Where automatic dampers may completely shut off air flow and subject plenum or casing to fan close off pressure, install pressure relief panels, rated to open at 125% of system operating pressure.

2.7 MISCELLANEOUS DUCTWORK MATERIALS

- A. General: Provide miscellaneous materials and products of the types and sizes indicated, and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs.

- C. Ductwork support materials: Except as otherwise indicated, provide galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- D. Duct liner adhesive:
 - 1. Manufacturers:
 - a. Design basis: Design Polymeric Model DP 2501 and DP 2502.
 - b. Other acceptable manufacturers: Childers Model CP-127, King Co. Model II-410, or Hardcast Model Glasgrip 981
 - 2. Description: Water based adhesive. Adhesive shall be used to encapsulate fiberglass duct liner that has been cut.
 - 3. Fire Rating with Class 1 rating with flame spread/smoke development of less than 25/50 when tested in accordance with ASTM E-84 (UL723, NFPA 90A and B).
- E. Duct Sealant:
 - 1. Manufacturers:
 - a. Design basis: Design Polymeric Model DP1010 and DP 1020.
 - b. Other acceptable manufacturers: United McGill (water based), Hardcast Model Irongrip 601, or Precision Model PA 3084.
 - 2. Description: Non-hardening mastic elastic sealant. Sealant shall be UL 181 Listed.
 - 3. Fire rating: Class I rating with flame spread/smoke development of less than 25/50 when tested in accordance with ASTM E-84 (UL 723, NFPA 90A and 90B).
- F. Duct tape sealing system:
 - 1. Duct tape shall be of fabric reinforced type. UL 181B-FX. Use of plastic duct tape is prohibited.
 - 2. Manufacturers: NASHUA 558CA or equal.
 - 3. California Energy Commission approved.
 - 4. Use of plastic duct tape is prohibited.
- G. Fiberglass ductboard is not accepted.

2.8 INSULATED FLEXIBLE DUCT

- A. Refer to specification section 23 30 00, 2.1.

2.9 AUXILIARY STEEL

- A. General: Provide auxiliary structural steel members for supports, seismic restraints and vibration isolators for ducts and equipment.
- B. All structural steel systems to be designed in accordance with AISC Steel Handbook.
- C. All systems to be secured to building structure or footings in a method acceptable to and approved by the Project Structural Engineer.

- D. Steel Work: Fabricate neatly. Grind off excess burrs and welding spatter. Paint with rust inhibitive primer. Apply finish topcoat where exposed to weather.
- E. Coordinate requirements for steel supports in shafts and elsewhere such that other trades may utilize the same support system.

2.10 MANUAL VOLUME DAMPERS

- A. Manual volume damper shall be provided at each branch duct for (1) supply air duct systems, (2) return air duct systems and (3) exhaust air duct systems, and where required for final air balance. At a minimum, provide damper at locations as shown in AABC "National Standards for Total System Balance", 2002 Edition Figure 6.1.
- B. Use 3/8" continuous square rod and 18 gauge galvanized stiffened blade for damper blade sizes (1) 18" wide by 18" high and smaller or (2) 12" diameter and smaller.
- C. Use 1/2" continuous square rod and 16 gauge galvanized stiffened blade for damper blade sizes 19" to 48" wide by 10" high. Maximum blade size shall be 48" by 10" high. Maximum diameter shall be 16".
- D. Maximum of Two Blades without a Frame: Over two blades, use a manufactured 16 gauge galvanized, stiffened, opposed blade damper in a 14 gauge galvanized steel frame. All hardware shall be galvanized except use brass unions and bronze oilite bearing; Pacific Air Products Series 200; Pottorff series 400, or equal.
- E. Quadrant shall be Durodyne Model 3/8" K-4/1/2" K-5 Quadline, Ventlock model 555 Ventline, or equal.
- F. Provide closed end bearing, Durodyne SB-338 (3/8")/SB-312 (1/2"), Ventlock Model 609, or equal.
- G. Cut slot in end of damper rod (Quadrant End) to indicate blade position.
- H. Provide galvanized sheet metal "hat section" on ducts with exterior insulation so that quadrant will be exposed.
- I. Each square rod shall be installed vertical or horizontal so that quadrant will be accessible for adjusting.
- J. Provide arm extension and remote damper controller where dampers are not readily accessible or located above in inaccessible ceilings.

2.11 DYNAMIC FIRE DAMPERS

- A. Fire Dampers: Design and construction in accordance with NFPA Pamphlet No. 90A and UL listed for use in dynamic systems. Installed in accordance with fire damper manufacturer's installation instructions. Shutter type, 100% free area.
 - 1. Manufacturer: Ruskin D1BD2 Style C or equivalent by Air Balance, Pottorff or Airstream.
 - 2. Frames: Galvanized steel with galvanized steel sleeve and provisions for attaching to ducts and securing to building structure.
 - 3. Provide dampers label per UL Standard 555. Fire rating of 1-1/2 hour unless otherwise noted.

4. Fusible Link: 165°F.

2.12 COMBINATION FIRE AND SMOKE DAMPERS

- A. Design and construction in accordance with NFPA 90A, UL 555 and UL 555S. Interlocking blade type. Installed in accordance with damper manufacturer's installation instructions. Furnished with microswitches and damper blade position indicator package.
- B. Manufacturer: Ruskin FSD60, Greenheck, or equivalent by air Balance or Pottorff.
- C. Frames: Galvanized steel with 16 gauge galvanized steel sleeve with provisions for attaching to duct and securing to building structure.
- D. Blades: opposed blade, 14 gauge air foil and silicone rubber seals to withstand 450°F.
- E. Provide damper label per UL 555. Fire rating of 1-1/2 hour. UL 555 classification and labeling as a leakage Class I, 350°F temperature.
- F. Actuator: Electric damper and actuator shall meet applicable UL 555 and UL 555S qualifications. Manufacturer: Belimo or equal.
- G. Resettable Reusable Link: Bi-Metallic Thermal Disc 165°F
- H. Damper blade position indicator package: The package shall include two position indicator switches linked directly to the damper blade to provide the capability of remotely indicating damper blade position. Damper reset from fire alarm system. Fusible link trips and spring action close damper with fire mode. Ruskin Mode SP100.
- I. Control: Damper to close when smoke is detected by a smoke detector furnished and wired under Division 28. One microswitch shall close when the damper is fully closed, and the other switch shall close when the damper is fully open to indicate damper position. Damper reset from fire alarm system. Fusible link trips and spring action close damper with fire mode.
- J. Coordinate with Division 26 to provide local on/off switch at each individual damper where required by the local code authority.

2.13 SMOKE DAMPERS

- A. Smoke dampers shall utilize multi-blade construction and shall meet all requirements for smoke dampers in accordance with the latest edition of NFPA 90A and UL 555S and shall bear UL label for leakage resistance Class I. The leakage rating shall not exceed 4 CFM/square foot at 1" w.g. Provide damper blade position indicator.
- B. Manufacturer: Ruskin SD60 low leakage smoke damper.
- C. Blades: Blade edge shall be silicone rubber designed to withstand 450°F. Jamb seals shall be stainless steel.
- D. Actuator: Shall be electric and bear the UL label and shall be factory installed by the damper manufacturer to constitute a UL rated package. Linkage shall be arranged to permit emergency manual operation of damper.

- E. Damper Blade Position Indicator Package: The package shall include 2-position indicator switches linked directly to the damper blade to provide the capability of remotely indicating damper blade position. Damper reset from fire alarm system. Ruskin Model SP100.

2.14 AUTOMATIC CONTROL DAMPERS

- A. Refer to Section 230900 "INSTRUMENTATION AND CONTROL FOR HVAC."

2.15 SOUND ATTENUATOR

- A. Description: Factory assembled unit, tested and certified by an independent acoustic testing laboratory, per ASTM E477. Provide test data taken within six months of submittal date.
- B. Manufacturer: IAC, Vibracoustics or equivalent.
- C. Construction:
 - 1. Casings: 22 gauge minimum galvanized steel with minimum 26 gauge perforated galvanized steel baffle in accordance with ASHRAE Guide recommended construction for high pressure ductwork. Seams locked form and mastic filled. Acoustic baffles use smooth bellmouth at inlet and discharge, attached to casing using tongue and groove connection. Provide vertical supports where baffles are horizontal.
 - 2. Acoustical Fill: Inorganic long fiberglass or mineral fiber packed under not less than 5% compression, and have a flame spread classification of 25, smoke development rating 15, and fuel contribution 20.
- D. Acoustical Performance: Sound trap tested by an independent testing laboratory and certified that units must meet the acoustic ratings. Meet local codes for fill erosion.

2.16 ACCESS DOOR

- A. Provide duct access doors with gaskets, hinged and with insulation where ductwork is indicated to be insulated. Access door with insulation shall have an internal sheet metal lining (sandwich type).
 - 1. Manufacturer:
 - a. Design Basis: Cesco Model HAD hinged.
 - 2. Other Acceptable Manufacturers: Ventfabrics.

2.17 DUCT AIR MONITORING STATIONS

- A. Description: Air monitoring stations shall be duct mounted, factory calibrated, and include manual volume control damper, airflow monitoring blades, and air straightening section. AMCA Standard 610-93 tested and bear the AMCA certified ratings seal.
- B. Manufacturer: Ruskin Model AMS 50 or equal.
- C. Application: Arena Bowl supply air duct.

- D. Control Damper: Heavy gauge extruded aluminum airfoil type with blade edge seal and flexible metal compression type jamb seals. Damper frame shall be 4" x 1", 0.081" thick with mounting flanges on both sides. Linkage shall be concealed out of the airstream and located within the damper frame to reduce pressure drop and noise, furnished with manual actuator.
- E. Airflow Monitoring Blades: Heavy gauge anodized extruded aluminum airfoil shaped fixed in 10" 16 gauge galvanized frame with measuring ports built into the monitoring blades.
- F. Air Straightening Section: 5" long 16 gauge galvanized sleeve attached to the monitoring blade frame.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK

A. General:

1. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" latest edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
2. See air handling unit and fan schedules for static pressure requirements. All fan pressures above 3" external static pressure shall be considered medium pressure.
3. Use 1.5 radius elbows where possible. Use square elbows with turning vanes otherwise.
4. Fabricate transition elbows turning vanes at correct angle so entering and leaving edges are parallel or tangent to air flow.
5. All branch duct take-offs shall use 45° laterals or 45° "pants-leg" type fittings.
6. Verify all dimensions at the site, making all field measurements and shop drawings necessary for fabrication and erection of sheet metal work. Dimensions of duct shown on design drawings are net free areas. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Check plans showing work of other trades and consult with architect in the event of any interference.
7. Fabricate ductwork in workmanlike manner with airtight joints, presenting smooth surfaces on inside, neatly finished on outside, construct with curves, bends, turning vanes to aid in easy flow of air.
8. Construct, brace and support ducts and air plenum to prevent sagging and to minimize vibration when fans are operating.
9. Maintain rectangular cross section of ductwork unless otherwise shown.
10. Provide duct access doors for all fire dampers, control devices, smoke detectors and combination fire/smoke dampers.
11. Use of "spin-ins" not permitted.
12. Flexible duct not permitted in areas with exposed construction.
13. Use of plastic duct tape is prohibited.
14. All duct joints in designated exposed areas on the drawings to be clean and smooth and prepared for painting by others.
15. Reapply protective coating to galvanized ductwork and accessories which have been welded. Use of product such as "Coldgalv" is acceptable.
16. For ductwork serving areas of high humidity (showers, steam rooms, etc.) slope ductwork 1/4" per foot toward air inlet or outlet and install duct seam at top or side of the rectangular duct.
17. Use of screws in ductwork serving laundry vents is prohibited.
18. Cleanouts shall be provided in grease exhaust ducts at all low points, at each change of direction at 10' on centers in horizontal runs. Doors in ducts shall be hinged.

19. Drains shall be provided at low point of dishwasher exhaust riser, piped to an approved receptor.
20. The size of ductwork indicated on the drawings shall be net inside dimensions.

B. Construction of rectangular galvanized steel ductwork:

1. Low pressure ductwork: Refer to the latest CMC and SMACNA "HVAC Duct Construction Standard", latest edition (DCS). Where CMC and SMACNA requirements differ, SMACNA DCS requirements shall govern.
2. Medium pressure ductwork: Refer to the latest CMC and latest SMACNA DCS. Where CMC and SMACNA requirements differ, the more stringent of the two shall govern. Seal all transverse joints, longitudinal seams and duct wall penetrations with approved sealant for Seal Class A per SMACNA DCS and Table 1-2. When duct reinforcement required on two sides, they shall be tied with rods at the ends.
3. Fittings and branch connections: Use 45° entry for rectangular and conical or bell mouth for round branch connections. Straight tap, flanged or spin-in fittings are not acceptable. Refer to SMACNA DCS, Figure 2-6. Transition fittings changing from rectangular to round made with transformation joint with minimum of 1 to 7 taper. Gauges to be 1 gauge heavier than connecting ductwork.

C. Construction of round ductwork:

1. Material: Spiral galvanized steel as manufactured by United Sheet Metal or equivalent by Omni Duct, Oreco, Clas Glas, Plenums Plus.
2. Construction: Refer to the latest CMC and SMACNA DCS. Where CMC and SMACNA requirements differ, SMACNA DCS requirements shall govern.
3. Fittings and connections for spiral ducts:
 - a. Use factory fabricated fittings as shown on drawings with radius of elbows and angle minimum of 1-1/2 times diameter of duct. Tee fittings of conical type or 45° lateral fitting. Refer to SMACNA DCS, Figures 3-4 and 3-5.
 - b. Joints between two ducts made with beaded sleeve joint with duct sealer applied to male end, mechanically fastened with sheet metal screws or pop rivets. Over joint and screw or rivet heads, apply coating of duct sealer.
 - c. Duct and fitting joined by slipping the projecting collar of the fittings into the pipe. Insertion length minimum of 2". Apply duct sealer and mechanically fasten per paragraph above.
 - d. Adjustable elbows permitted only in pressure class of 2" w.g. and less. Elbows to be 4 gore type with continuous duct sealant at each gore joint. Short radius acceptable for low pressure system.
 - e. Fittings to be 1 gauge heavier than connecting ductwork.
 - f. Elbows in medium pressure systems shall be stamped or adjustable with each zone continuously included.

D. Bracing: Refer to 1995 SMACNA DCS, applicable tables and figures. Provide tie rod or angle at the ends where reinforcement requires on two sides for the medium pressure duct.

E. Duct Supports:

1. Support horizontal ducts with trapeze type hanger with all-thread rod for exposed areas; concealed areas can utilize strap type hangers of schedule size and spacing per SMACNA DCS, Tables 4-1 and 4-2 but not more than 10' apart. Install hangers at each change in direction of duct.
2. Extend strap hangers down both sides of ducts, turn under bottom 2" minimum. Metal screw hangers to bottom of duct and to upper and lower sides of ducts at not more than 12" on center.

3. Provide angle hangers formed by extending vertical bracing and angles or by rods connecting to bottom angles if size of bracing angles conforms to hanger schedule.
4. Support vertical ducts at every floor with angles or channels riveted to ducts. Rest angles or channels on floor slab or structural steel members placed in opening, otherwise noted.
5. Construct hangers of galvanized steel.
6. Provide hangers for duct as recommended by SMACNA.
7. Power driven anchor not permitted unless approved by Project Structural Engineer and Architect.
8. Provide field applied primer finish to supports exposed to weather.
9. Provide duct sealant at all duct wall penetrations using product appropriate to duct pressure class.

F. Manual Balancing Dampers:

1. Provide manual balancing dampers (not all dampers are shown on drawings) where required to facilitate air distribution and balance. Reference AABC "National Standards for Total System Balance, 2002 Edition", Figure 6.1 as guideline.
2. After final adjustment of system, lock quadrants and mark clearly showing damper position.
3. Provide fluorescent colored plastic tape at dampers to facilitate identification by air balancer.

G. Tapers:

1. Pitch sides of duct in a "diverging" airflow maximum of 20°.
2. Pitch sides of duct in a "converging" airflow maximum of 30°.

H. Design elbows for minimum friction with inside radius not less than width of duct. Use square elbows with hollow double radius type duct turns where radius is less than duct width. For duct 18" and wider, use minimum 24 gauge vanes at 3-1/4" o.c. attach duct turns to duct securely with spot weld, screws, or rivets. Friction type attachment not acceptable. Tack welding of each turning vane to track required where elbows are within 20 feet of fan inlet or discharge.

I. Test holes: Drill instrument test holes into ductwork for Pitot tube tests. Install hole covers attached to ductwork by sheet metal screws. Locate test holes at intake, return and discharge from each air handling unit. Ventlok No. 699.

J. Flashing ducts through roof: Provide factory fabricated curb with rain collar soldered to duct for each duct penetrating through roof unless otherwise detailed on the drawings.

3.2 ALUMINUM DUCTS (unless noted on plans)

- A. Aluminum ducts shall be installed with the longitudinal seams located at the top side of the duct.

3.3 EXHAUST DUCT FIRE WRAPPER

- A. Installation of exhaust duct fire rated wrapper shall be strictly in accordance with manufacturer's instruction and require approval from local code authority.
- B. Provide trapeze type hanger for all exhaust ducts with fire rated wrapper per fire wrapper manufacturer's requirement.

3.4 LINING

- A. Line ductwork as indicated on drawings:
 - 1. Use one inch lining except where noted otherwise.
 - 2. Dimensions indicate net free area.
- B. Ducts exposed to weather: Line all ducts exposed to weather with two inch thick R-8.0 lining, except ductwork serving clean room and/or supply air ducts for patient areas.
 - 1. Seal ducts to three inch static pressure standards.
 - 2. Paint exposed surfaces with aluminum asphalt roof paint.
- C. Supply and return air ductwork which is not lined (as noted above) is to have exterior insulation. See Section 230700, HVAC INSULATION for insulation requirements on unlined work.
- D. Provide sheet metal nosing at exposed edges at access doors in ductwork and plenums.
- E. Seal all exposed ends of liner with duct liner adhesive back a minimum of 2" from ends. Seal all joints in liner a minimum of 1" overlap. Seal all fasteners.
- F. Completely remove any loose material from each section of lined ductwork as it is installed.
- G. Interrupt duct liner a minimum of 18" upstream and 30 inches downstream of all electric resistance heaters in duct system where applicable. If ductwork is used for cooling, wrap that portion of duct which is not lined and extend insulation a minimum of 12" beyond lining in each direction.

3.5 DUCT PRESSURE/LEAK TESTS

- A. Tests shall be performed by the Mechanical Contractor per the requirements and recommended procedures as outlined in Section 230593, "TESTING, ADJUSTING AND BALANCING FOR HVAC."
- B. Provide certification at the end of the tests.

3.6 PROTECTION OF DUCTWORK

- A. Protection:
 - 1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
 - 2. Cover all stored ducts to protect from moisture or debris.
 - 3. Cover all ends of installed ductwork at the end of each workday or when dust and debris producing construction (such as fire proofing, drywall, sanding, or core drilling) is occurring.
- B. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the satisfaction of the Owner's Representative.
 - 1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
 - 2. Ductliner in installed ductwork which has become wet must be completely removed and replaced.

3. Torn ductliner may be repaired by coating with adhesive if damage is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

3.7 INSTALLATION OF ACCESSORIES

- A. Install fire and ceiling dampers in accordance with manufacturer's instructions and Fire, Smoke and Radiation Damper guide for HVAC Systems, published by SMACNA.
- B. Install access doors where necessary for inspection and maintenance.
 1. Provide 12" x 12" access door at each low leakage damper, fire damper, combination fire/smoke damper and smoke damper.
 2. Arrange access doors so that;
 - a. They open against the system air pressure, wherever feasible.
 - b. Their latches are operable from either side, except where the duct is too small to be entered.
 3. Provide access door at side of duct. If side of duct is not feasible (e.g. height of duct is less than 14" or lack of clearance in front of access door), install access door at bottom of duct as an alternate location, providing the access door is readily accessible and has adequate clearance in front. Determine location at the field.
- C. Use of flexible duct upstream of air terminal units is not permitted.
- D. Notify fire alarm provider of smoke damper control requirements and fire alarm interlocks.
- E. Install flexible ductwork without tight bends and free of kinks.
 1. Insulated flexible ducts shall be continuous, maximum of 7' and minimum of 4' in length. Flexible ducts shall not penetrate any fire or smoke barrier.
 2. Flexible ductwork shall be installed with a "minimum length of straight duct" upstream of the diffuser neck inlet. Unless defined differently on the drawings, "a minimum length" shall mean a length equal to three (3) duct diameters. Unless defined differently on the drawings, "straight duct" shall mean the centerline of the duct shall be aligned with a line perpendicular to the plane of the diffuser neck opening at the center point of the opening.
- F. Install all dampers, including those furnished by Section 230913, BUILDING CONTROL SYSTEMS Contractor.
 1. Caulk damper frames to ductwork.
 2. Make sure dampers are free to operate properly.
 3. Install parallel blade mixing dampers to two streams impinge on each other to facilitate mixing.
- G. Provide protective sheet metal cover at top and 6" down each side of flexible duct connectors exposed to weather.
- H. Provide seismic restraint for sound attenuators.
- I. Install duct air monitoring stations in accordance with manufacturer's instructions. Locate stations per contract drawings and directly above catwalks. Provide adequate straight duct upstream and downstream of station per manufacturer's recommendations.

3.8 CLEANING

- A. Clean ductwork internally, of dust or debris, at the factory with all duct ends to be capped prior to shipping. The end caps shall stay intact until the section is ready for installation. Owner's Representative shall routinely inspect installed duct section for cleanliness and compliance of this section.
- B. Clean external surfaces of foreign substances which might cause corrosion of metal, damage to insulation, or deterioration of paint.
- C. After duct systems have been installed, blow out all dirt, debris, and foreign matter from ductwork by using the system air handling unit or fan. During this blowout period, the air handling unit shall be placed under full economizer cycle with the return air exhausted 100%. Clean all diffusers, register, and grilles after the blowout period.
- D. Provide letter to state that all duct systems (interior and exterior) have been cleaned.
- E. The Owner's Representative shall inspect the cleanliness of all diffusers, register, and grilles, and interior and exterior (select several locations at each floor) of ductwork. For any devices and/or locations found unacceptable, the contractor shall provide additional cleaning at the failed devices and/or locations at no extra cost to the Owner.
- F. Refer to Section 230500 "COMMON WORK RESULTS FOR HVAC," for additional cleaning requirements for existing ductwork.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

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: For each product.
 - 1. Single inlet, single width backward-inclined airfoil centrifugal fans.
 - 2. In-line backward inclined centrifugal fans.
 - 3. Forward-curved centrifugal fans.
 - 4. Floor mounted, hooded tubular centrifugal supply fan.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Dampers, including housings, linkages, and operators.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts: One.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
 - 2. Operating Limits: Classify according to AMCA 99.
- B. Unusual Service Conditions:
 - 1. Ambient Temperature: 101°Fwb and 71°Fwb.
 - 2. Altitude: 27 ft. above sea level.
- 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. Capacities and Characteristics: (See equipment schedule)

2.2 BACKWARD-INCLINED AIRFOIL CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by 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. Greenheck.
 - 2. Loren Cook.
 - 3. Chicago Blower.
 - 4. New York Blower Company.
- C. Description: Fan shall be single width, single inlet backward inclined airfoil, belt driven centrifugal blower.
- D. Certifications:
 - 1. Motor for belt driver should be NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

2. Fan shall be floor mounted, belt driven centrifugal.

E. Construction:

1. The fan shall be bolted and/or welded construction utilizing corrosion resistant fasteners. The scroll wrapper and scroll side panels, shall be aluminum.
2. The entire fan housing shall have continuously welded seams for leakproof operation and shall have a minimum 1 1/2 " outlet discharge flange.
3. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing.
4. Bearing support shall be minimum 10 gauge welded steel.
5. Lifting eyes shall be provided for ease of installation.
6. Unit shall bear an engraved aluminum nameplate.
7. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.
8. Unit shall be shipped in ISTA certified transit tested packaging.
9. Provide horizontal split housing.

F. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: **1.5**].
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: Aluminum pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material (aluminum) as housing (inlet and outlet)
4. Inlet/Outlet and Flanged inlet:
5. Spark-Resistant Construction: AMCA 99, Type A, all aluminum construction.
6. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
7. Explosion proof inverter duty motor.
8. Horizontal split fan housing.
9. Inertia base.

2.3 IN-LINE BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.

2. Loren Cook.

C. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt or direct driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

D. Certifications:

1. Motor for belt driver should be NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
2. Motors for direct driver.
3. Fan shall be duct mounted, belt driven centrifugal square inline.

E. Construction:

1. The fan shall be bolted and/or welded construction utilizing corrosion resistant fasteners. The fan housing shall be a minimum 18 gauge steel.
2. Lifting eyes shall be provided for ease of installation.
3. Unit shall bear an engraved aluminum nameplate.
4. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.
5. Unit shall be shipped in ISTA certified transit tested packaging.

F. Housings:

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontally split, bolted-flange housing.
3. Spun inlet cone with flange.
4. Outlet flange.

G. Pre-lubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: AMCA 9, L10 at 50,000.
3. Roller-Bearing Rating Life: AMCA 11, L10 at 50,000.

H. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: AMCA 9, L10 at 50,000.
3. Roller-Bearing Rating Life: AMCA 11, L10 at 50,000.

I. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5HP; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

5. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.

J. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.

K. Bearings:

1. Heavy duty regreasable ball type.
2. Cast iron housing.
3. Minimum L50 life, 200, 600 hours at maximum catalog to operating specifications.

L. Motors:

1. Direct Drive.

2.4 FORWARD-CURVED CENTRIFUGAL FANS

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 a comparable product by one of the following:

1. Greenheck.
2. Loren Cook.

C. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Standard plug disconnect switch.

D. Certifications:

1. Motor for belt driver should be NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
2. Motors for direct driven.
3. Fan shall be direct driven as specified on plans.
4. Ceiling mounted fans shall be furnished with aluminum grille.

E. Construction:

1. The fan shall be bolted and/or welded construction utilizing corrosion resistant fasteners. The scroll wrapper and scroll side panels shall be a minimum 12 gauge steel.
2. The entire fan housing shall have continuously welded seams for leakproof operation and shall have a minimum 1 1/2 " outlet discharge flange.
3. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing.
4. Bearing support shall be minimum 10 gauge welded steel.

5. Lifting eyes shall be provided for ease of installation.
6. Unit shall bear an engraved aluminum nameplate.
7. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.
8. Unit shall be shipped in ISTA certified transit tested packaging. Provide horizontal split housing.

2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.6 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting: Install centrifugal fans, as indicated on drawings.
- E. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, alignment of fan shaft and motor shaft, alignment of pulleys, belt adjustments, and lubrication, and to report results in writing.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.

- C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.3 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 test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. See Division 23 Section "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
 - 10. Repair or replace malfunctioning units and retest as specified above.
- D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

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:
 - 1. Ceiling-mounted, 4-way, adjustable modular core diffusers.
 - 2. Return air registers.
- B. Related Sections include the following:
 - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

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, or approved equal.

2.2 CEILING DIFFUSERS – 4-WAY ADJUSTABLE MODULAR CORE DIFFUSERS

- A. Manufacturer (Model)
 - 1. Titus Model PMC for T-Bar ceiling.
 - 2. Titus MCD for hard lid ceiling or approved equal to Krueger and Price.

2.3 RETURN AND EXHAUST AIR REGISTERS

- A. Manufacturer (Model)
 - 1. Titus with OBD PMR for T-Bar Ceiling
 - 2. Titus 350RL with OBD for hard lid ceiling or approved equal to Krueger or Price
 - 3. Titus (Model 50F) aluminum with OBD as noted on plan
- B. Material: Aluminum.
- C. Finish: Baked enamel, color selected by Architect.
- D. Face Style: Four egg crate.

2.4 SIDEWALL SUPPLY REGISTERS

- A. Titus 300RS with OBD or approved equal to Krueger or Price furnish with OBD fixed bars, pencil proof aluminum. 7/32" bars 0 degree deflection heavy duty mounting frame type "J".

2.5 APERTURE DAMPER

- A. Outlets shall include an integral aperture damper. Damper shall have an adjustment knob constructed from aluminum. Connecting linkage, tension springs and damper hardware shall be constructed from stainless steel.
- B. Outlets shall be constructed of heavy gauge aluminum and available in 6", 8", 10", 12", 14", 16", 18" and 20" diameters. Finish, to be selected by the Architect, shall be white or aluminum pain, mill finish, or clear anodized finish.
- C. The manufacturer shall provide published performance data. Data shall be tested in accordance to ANSI/ASHRAE Standard 70-1991.

2.6 PAINT SPECIFICATION

- A. Process shall be anodic electrodeposition using an anodic acrylic paint. Units shall undergo pre-treatment, including a pressurized spray stage using an alkaline cleaner and a de-ionized water rinse.

2.7 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed by Owner, before starting air balancing.

END OF SECTION

SECTION 23 81 26

SPLIT SYSTEM AIR CONDITIONERS

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 split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts, or standalone systems.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Refer to Division 01 Section "Product Requirements."
- 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. Energy-Efficiency Ratio: Equal to or greater than prescribed by 2005 Energy Efficiency Standards "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings." (Minimum SEER 13.0 for cooling operation & minimum HSPF 7.7 for Heat Pumps).
- D. Coefficient of Performance: Equal to or greater than prescribed by 2008 Energy Efficiency Standards.
- E. Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

- A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 1 year for parts and repairs.
 - 2. Warranty Period: 5 years for compressor.

1.7 EXTRA MATERIALS

- 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.
 - 1. Filters: One set of filters for each unit.
 - 2. Fan Belts: One set of belts for each unit.
 - 3. Line hide set – Refer to section for "Refrigerant Piping".
 - 4. Condensate: Provide condensate drain pipe from fan coil to terminate to an approved plumbing fixture or disposable area with a slope of not less than 1/8-inch per foot. If required slope is not achieved, provide condensate pump.
 - 5. Controls: Provide controls based on manufacturer's recommendation.

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. Carrier.
 - 2. York International/JCI- by USACD.
 - 3. Trane.
 - 4. Or approved equal.

2.2 WALL MOUNTED FAN COIL UNITS

- A. General: Indoor, direct-expansion, fan coil. Unit shall be complete with cooling/heating coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.
- B. Unit Cabinet: All air handler cabinets are thermally insulated with 1" foil faced insulation (R-4.2) to prevent sweating. For applications in extreme humidity conditions an optional, field installed, external insulating wrap kit is also available. Durable Finish Inside and Out - Air handler casings are made of pre-painted galvanized steel which provides a better paint to steel bond that resists

corrosion and rust creep. All internal coil sheet metal parts are made of G90 pre-painted steel (i.e. triangular plates, top plates, horizontal supports, etc).

- C. Motor: Shall be variable speed DC motor.
- D. Coil: All air handler coils are treated with the MicroBlue™ hydrophilic coating to enhance the removal of condensate during the refrigeration cycle and reduce the possibility of water blow-off. The MicroBlue™ coating also reduces the growth of germ causing microbes for a healthier home environment
- E. Fan: Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection.
- F. Controls: All 24V control circuit, powered by a 24V transformer and protected by a resettable breaker:
 - 1. Conventional thermostat must provide operation for both condensing units and heat pumps without an "O" output from the thermostat.
 - 2. Compressor motor protection shuts down unit for motor over-current, over-temperature or low voltage conditions.
 - 3. Safety lockouts provide reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor: a. Loss of charge/Low pressure switch. b. High pressure switch. c. Control board diagnostics and fault code display. d. Safety lockouts send a 24V signal to the control board's "x" terminal, allowing notification to the user via the thermostat fault light (if present). e. Control board shall retain last 5 fault codes in non-volatile memory, which will not be lost in the event of a power loss.
- G. Filters: Unit shall have a filter track with factory-supplied 1" filters.
- H. Refrigerant Lines: All units should have refrigerant lines that can be oriented to connect from the left, right or back of the unit. Both refrigerant lines need to be insulated.

2.3 CONSTRUCTION FEATURES

- A. Cabinet
 - 1. Construction shall be a single, enclosed, weatherproof casing constructed of 20-gauge galvanized steel. Unit base is constructed of 16-gauge galvanized steel. Each exterior casing panel to be bonderized and finished with baked-on exterior polyester enamel paint prior to assembly. The baked-on cured paint finish shall pass the industry rub test with a minimum of 72 rubs MEK (Methyl Ethyl Ketone) or standard rub test of a minimum of 100 rubs using Tolulene. Cooling section shall be fully insulated with 1-inch fiberglass to prevent sweating and to muffle sounds. Openings shall be provided for power connections. Access openings appropriate for outside structure to all fan motors and compressor for making repairs and for removing internal components without removing unit from its permanent installation. Outdoor coil shall be protected from intrusions by a sturdy metal grating with less than 1/4 inch openings.
- B. Colors (Select One)
 - 1. Shall be selected by Architect.
- C. Drain Pan
 - 1. Drain pan shall be constructed of 20-gauge galvanized steel, bonderized and finished with baked-on exterior polyester enamel paint.

- D. Insulation
 - 1. Insulation shall be foil faced for ease of cleaning.
- E. Mounting Brackets
 - 1. Full-length side mounting brackets shall be an integral part of the cabinet. Bottom mounting bracket shall be provided.
- F. Refrigeration System
 - 1. All models shall use a high efficiency scroll compressor. The compressor shall be covered by a 5-year parts warranty. The refrigeration circuit shall be equipped with factory installed high and low pressure controls and liquid line filter dryer. The refrigeration control shall be a factory installed capillary tube. Compressor shall be mounted rubber grommets. Unit shall be provided with R-410A (HFC) non-ozone depleting refrigerant.
- G. Condenser Fan Motor
 - 1. The condenser fan, motor and shroud shall be of slide out configuration for easy access.
- H. Indoor Blower Motor
 - 1. The indoor blower motor shall be twin wheels with forward curve blades. Motor shall be high efficiency PSC type.
- I. Electrical Components
 - 1. Electrical components are easily accessible for routine inspection and maintenance through front service panels. Circuit breaker is standard on all 208/230-volt models. Circuit breaker access is through lockable access panel.
- J. Control Circuit
 - 1. The internal control circuit shall consist of a current limiting 24VAC type 50VA transformer. The defrost circuit shall consist of a solid-state electronic heat pump control. A 30-minute timer shall inflate a defrost cycle if the outdoor coil temperature indicates the possibility of an iced condition. The thermistor sensor, speed-up terminal for service, and a ten-minute defrost override shall be standard on the electronic heat pump control. To prevent rapid compressor short cycling, a five-minute time delay circuit shall be factory installed. A low-pressure bypass shall be factory installed to prevent nuisance tripping during low temperature start-up.
- K. Ventilation Options
 - 1. WH models are designed to provide optional ventilation packages to meet all of your ventilation and indoor air quality requirements. All ventilation packages are factory or field installed, and easily removable for service.
- L. Blank Off Plate
 - 1. A blank off plate covers the air inlet openings that restrict any outside air from entering the unit. The blank off plate should be utilized in applications where outside air is not required to be mixed with the conditioned air.
- M. Filter
 - 1. 2" Fiberglass – Pleated
- N. Unit Control Options
 - 1. Low ambient control
 - 2. High pressure control
 - 3. Outdoor air thermostat

- O. Operating Controls (Field Installed)
 - 1. Electronic programmable, auto changeover
- P. Installation
 - 1. Installation shall be done in strict adherence to Bard's Installation Instructions.
- Q. Hot Gas Reheat
 - 1. The dehumidification circuit incorporates an independent heat exchanger coil in the supply air stream in addition to the standard evaporator coil. This coil reheats the supply air after it passes over the cooling coil, and is sized to nominally match the sensible cooling capacity of the evaporator coil. Extended run times in dehumidification mode can be achieved using waste heat from the refrigeration cycle to achieve the reheat process, while at the same time large amounts of moisture can be extracted from the passing air stream. Models that also have electric heaters installed have the electric heat inhibited during dehumidification mode, although it remains available for additional reheat during certain conditions. The dehumidification cycle shall be energized by a rise in relative humidity above set point. The unit shall energize in the cooling mode and also a two position valve will energize, allowing hot refrigerant gas to pass thru the reheat coil, reheating the cold air leaving the evaporator coil. The dehumidification cycle shall have on/off capability. If the thermostat calls for cooling or heating during the dehumidification cycle, the unit shall drop out of dehumidification to satisfy the call from the thermostat. A solid state circuit board shall control the dehumidification function. The dehumidification option shall be factory installed.
- R. Warranty
 - 1. The Bard product specified shall be free from defects in materials and workmanship for a period of 5 years for compressor, and for a period of 5 years for all parts. Warranty period shall start from date of installation as stated on warranty card; or from date of shipment if no warranty card is returned to Bard Manufacturing. Equipment must be used under normal conditions and warranty is subject to Bard Manufacturing's standard limited warranty statement.

2.4 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS (OUTDOOR UNIT)

- A. General: The outdoor unit must be a two-stage heat pump product, which meets up to 18 SEER minimum efficiency as rated in a matched system under the ARI certification program. The design shall provide for easy access to the electrical compartment and compressor, and be factory wired and tested. Top discharge is required to direct exhausted air away from the structure or surrounding landscaping. Operating sounds are to be minimized by using upward discharge, cushioned compressor mounts, and rigid top panel to isolate motor sounds/ vibration.
- B. Unit Cabinet: The unit cabinet shall be constructed of durable galvanized steel with a zinc coating which provides a paint-to-steel bond that resists corrosion and rust creep. Special primers and an automotive-quality powder paint finish should be used to reduce paint fading from sunlight exposure. The paint process shall meet or exceed one thousand salt spray hours of testing under ASTM B117 standards. All internal sheet metal parts shall be made of G40 galvanized steel. The base pan shall be a formed unit constructed of 18 gauge G90 galvanized steel. Unit cabinets shall include a heavy-duty rolled wire coil guard system and corner posts for additional cabinet strength. Cabinets shall be designed so that multiple units can be stacked above each other.
- C. Fans: Fan shall be a direct drive blower assembly, with a single speed PSC motor and a propeller type fan assembly. Bearings shall be permanently lubricated for longer life and low maintenance. The motor wiring shall be connected within the control box for ease of service

- D. Compressor: Shall be two speed hermetic type, direct drive, internally protected with high pressure relief and over temperature sensors. The hermetic motor shall be suction gas cooled and have a voltage range of +/- 10% of the unit nameplate voltage. Internal spring isolation and sound muffling is required to minimize vibration and operating noise. The compressors shall be externally isolated as well using independent mounting methods. Hard start kits shall be available for non-scroll compressor applications when required
- E. Outdoor coils: Shall have aluminum plate fins that are mechanically bonded to seamless, internally enhanced copper tubes with all joints brazed. These shall be direct expansion, draw-through design style coils. The unit must include a bi-flow filter-dryer on the liquid line. Refrigerant connections must be sweat fit, include re-usable brass service valves for both liquid line and vapor line and be fully exposed for installation and service access.
- F. Controls and Safeties: Unit controls shall include a 24-volt control circuit. All wiring shall be color-coded for easy service and troubleshooting.

2.5 FAN COIL UNITS

- A. General:
 - 1. Except as otherwise indicated, provide fan coil unit manufacturer's standard materials and components as indicated by his published product information, designed, constructed, and assembled by the manufacturer. Units shall be certified in accordance with ARI 440-84. Unit capacities shall be certified in accordance with ARI Standard 441-66. Unit sound data shall be rated in accordance with ARI Standard 443-70.
 - 2. Factory fabricated, chilled water, fan coil units of the size, type, configuration, and capacities as scheduled on the drawings.
 - 3. All pressure drops, horse powers and dimensions shown are maximum allowable. All capacities shown are minimum allowable. All units must have AMCA certified performance data for fans tested in the unit casings. Bare fan certification without casing is not acceptable.
 - 4. Units shall be capable of providing modulating cooling with control valves and sensors to be provided by the Controls Contractor.
- B. Manufacturers:
 - 1. Carrier
 - 2. Daikin
 - 3. Trane
 - 4. Or approved equal.
- C. Capacity: Heating and cooling capacities and fan characteristics shall be as scheduled or shown on the Drawings and shall be ARI-certified.
- D. Cabinets: Cabinets shall be fabricated of 18-gauge, cold rolled steel or galvanized steel factory painted, designed to provide a rigid structure for lasting durability and peak performance. Cabinets shall be reinforced for maximum rigidity. Removable panels shall be provided on each side of cabinet for ease of installation and maintenance. The entire interior of the cabinet shall be insulated both thermally and acoustically with 1/2" thickness of fiberglass neoprene insulation with black flame-resistant coating. Insulation shall meet NFPA 90A and ASTM E84-70 with flame spread of less than 25 and smoke developed of less than 50 requirements and be UL-listed and labeled.
- E. Coils: unit shall be equipped with standard capacity 4-row chilled water-cooling coil. Coils shall have copper tubes with aluminum fins bonded to the tubes by mechanical expansion. Coils shall

have a working pressure of 400 psig at 200 F. Each coil shall have sweat connections for copper tubes and shall have manual air vent(s).

- F. Water Coils: The coils shall consist of minimum 1/2" OD, 0.020" wall thickness copper tubes, mechanically expanded into aluminum fins. Coils shall have a maximum of 12 fins per inch and coil water and air pressure drops shall not exceed the scheduled maximums. All copper tubes and headers shall be constructed of seamless copper. All water coils shall be furnished with an air vent and drain valve. Coils shall be tested at 350 psig air pressure and are suitable for 250 psig working pressure. Hot water coils shall be mounted in preheat position, unless otherwise noted.
- G. Drain Pans: All drain pans shall be fabricated of 304 Stainless Steel construction and insulated with a closed cell polyurethane or polyisocyanurate that is sprayed and into every crevice of the drain pans. Drain pan shall have an integral auxiliary drainpipe connection located above primary drain connection to provide an auxiliary drain connected to "tell- tale" drain piping. Insulation shall be Underwriters' Laboratories, Inc. listed and labeled. Drain pans shall be pitched for positive drainage with the fan coil unit installed level.
- H. Fans: Belt-driven, double-width fan wheels shall have forward-curved blades and be statically and dynamically balanced. Fan drive shall consist of variable-pitch motor pulley, fixed-pitch fan pulley and V-belt. Fans and scrolls shall be of galvanized steel.
- I. Fan Wheels: Fan wheels shall be mounted on a solid steel shaft with ball bearings, all fan wheels shall be heavy duty, galvanized steel, double inlet, forward-curved blade, centrifugal direct-drive or belt-drive type, as scheduled. The wheels shall be dynamically and statically balanced for smooth, quiet operation.
- J. Motors: Single Phase motors shall be high efficiency, permanent split capacitor ball bearing type motors with thermal overload protection for direct drive fans and high efficiency, open-drip-proof motors for belt drive fans and shall be provided with resilient mount. For dual drive motors, each motor shall be protected with thermal overload protection. For direct driven fractional horsepower fan coil units, provide a solid-state speed controller mounted at Fan Coil Unit to adjust speed for balancing air flow. For large fan coil units, motors shall be three-phase premium efficiency type. See related sections for additional motor requirements. Fan motors shall be single-speed, 1750 rpm, 60 Hz, single phase 115 volts (60 Hz), suitable for continuous duty at 104-°F (40 °C).
- K. Casing: Construction shall be heavy gauge galvanized steel, painted with baked on polyurethane based powder coating, lined with 7/8" closed-cell thermal/acoustical insulation. Knockouts acceptable for 3/8-in threaded rod shall be provided at the top and bottom of all unit corners for hanging the unit. Supply and return duct connections shall be approx. one inch long (04 - 40 only). Removable side panels shall be provided for access to the fan/motor assembly. A Type 304 stainless steel, coated, double-sloped IAQ drain pan shall extend under the full length and width of the coil(s) with a 3/4 -in FPT connection.
- L. Filters: Provide Type F-1B - Basin Boy throwaway filters of glass fiber, one inch (1") thick unless scheduled or shown otherwise on the Drawings. Filters shall be 2" pleated media, MERV- 7, as indicated on the equipment schedule.
- M. Factory Finish: Finish shall be bonderized, phosphatized, baked-on primer, and baked- on enamel.
- N. Accessories: Provide units with accessories as scheduled or shown on the Drawings and as required for a complete installation. Typical accessories shall include, but not be limited to:

supply, return and outside air duct connections, internally insulated return air plenums, filter racks, filters, access doors and similar accessories.

- O. Single Point Power Connection: Provide single point power connection, including fan motor relay, disconnect switch, and power supply to VAV controller. Fan relay motor shall be provided in a NEMA-12 enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground mounting, compressor-condenser components on 4-inch- (100-mm-) thick, prefab polymer pad; 4 inches (100 mm) larger on each side than unit.
- D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in Section 232300 "Refrigerant Piping."
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
- C. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- D. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a certified representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on drawings.
- C. Electrical service entrance equipment (arrangements for temporary and permanent connections to the utility's system) shall conform to the utility's requirements. Coordinate fuses, circuit breakers and relays with the utility's system, and obtain utility approval for sizes and settings of these devices.
- D. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 BASIC ELECTRICAL REQUIREMENTS

- A. Conference prior to commencement of work: Immediately upon the award of the Contract and before any electrical work is commenced, the Contractor shall confer with the Owner.
- B. Utility company requirements: Contact the serving utility companies and verify compliance with their requirements for lighting, power, and telephone service. Comply with all requirements of the utility companies. Deviations from the plans and specifications shall be approved by the Engineer before installing the work.
- C. Permits and inspections: The Contractor shall obtain and provide to Metro costs for all permits, licenses, utility company charges, and fees required for the execution of this work. Metro will be responsible for paying for all associated fees.
- D. Final inspection: Furnish evidence of final inspection and acceptance by the Building and Safety authority having jurisdiction upon completion and before acceptance of the work.
- E. Codes and ordinances: Perform all work in accordance with the Electrical Code of the City of Calexico, State of California, Title 24, Part 3 and California Electrical Code (CEC) latest edition. Nothing in the plans and specifications shall be construed as authority to violate ordinances and codes.
- F. Survey of existing work and conditions: The bidder shall visit the site and make a survey of existing conditions which may affect or be affected by the work under this Section. References made in these specifications or on the drawings to existing work or correctness of ways and means of performing the work under this section, in conjunction with existing conditions, shall be subject to verification by the Contractor in his survey and in the progress of the work. The

survey shall be made a time which has the approval of those occupying the premises and before bids are made.

G. Shop drawings:

1. Before manufacture and within 45 days after issuance of IFC documents, submit manufacturers' shop drawings of each type of fabricated equipment in quintuplicate to the Engineer for approval. Shop drawings shall include schematic diagrams, wiring diagrams, complete nameplate data, and operation instructions and manuals.

H. Operation and guarantee of electrical systems:

1. Demonstrate in the presence of the Engineer and Owner that all portions of the electrical work are operating or are in operating condition.
2. Guarantee all installed equipment, materials, and workmanship for a period of one year from the date of acceptance of the project by the Owner. Repair or replace promptly upon notification of the Owner or Engineer, at no additional cost, any defects due to faulty materials, methods of installation, or workmanship.

I. Clearances and interferences:

1. Locate outlets, equipment, wireways, apparatus, etc. in such a manner as to avoid conflict with materials and equipment installed under other sections, preserving head room and clearances, and keeping openings and passageways clear.
2. Carefully examining contract drawings.
 - a. To verify that work can be installed without confliction.
 - b. To maintain close coordination with work under other sections, particularly as to quantity, locations, size, and arrangement of equipment.
3. Report any deviations from the contract drawings to the Engineer before installing the work.

J. Equipment data: The Contractor shall furnish, in triplicate at the completion of the job, the following information on equipment furnished under this section.

1. Transfer panels, switch gear, main switchboards, all relays, manual and emergency equipment, fire alarm system, remote controlled lighting by photocell or manual.
2. Complete nameplate data (including weight of larger units) and local address and telephone number of vendor of equipment installed for motors, transformers, switchboards, distribution boards, control panels, power panels, lighting panels, switches, circuit breakers, pilot devices in controls, lighting fixtures, switches, receptacles and plates, and all control equipment mentioned in subparagraph (1).
3. Operation instruction and manuals.
4. Parts catalogs, showing manufacturer's parts number for procuring future replacements.

K. Record drawings:

1. Record drawings shall be separate, clean prints of the electrical drawings which will be issued by the Engineer and which shall be reserved for the purpose of showing a complete picture of the work as actually performed, including accurately dimensioned locations of all conduit stub-outs and routing of all conduits and/or cables extending from or between buildings.
2. Drawings shall be kept up to date with neat and legible annotations made thereon daily as the work proceeds, showing the work as actually installed. Drawings shall be available at all times for inspection, and shall be kept on the job at a location designated by the Owner.
3. Record drawings shall be inspected and approved by the Engineer before covering any work.
4. The Contractor, for his convenience, may use an additional set of prints for daily field annotations. This set of prints shall be kept at job site and the data shall be transferred to the final record drawings before acceptance of the work.

5. Final record drawings shall be submitted with floor, room, panel directories and all other identification necessary to conform to number designations for occupancy rather than by construction numbers.
 6. At completion and before acceptance of the work, record drawings shall be signed, with date, and returned to the Engineer.
- L. Operation of electrical system: Before acceptance of the work, the Contractor shall demonstrate in the presence of the Owner and Engineer that all portions of the electrical work are operated or in satisfactory operating condition.
- M. Tests:
1. The Contractor shall conduct tests of any portion of the installation as may be necessary to insure full compliance with the plans and specifications by closeout. Tests shall be made in the presence of the Owner or his designated agent and authority having jurisdiction or inspector of record. Costs of tests shall be borne by the Contractor and the Contractor shall provide all instruments, equipment, labor and materials to complete the tests. These tests may be required at any time between the installation of the work and the project closeout.
 2. Should these tests develop any defective materials or poor workmanship or variance with the requirements of the specifications, then the Contractor shall make any changes necessary and remedy any defects at his own expense.
- N. Clearance and interference with work:
1. The electrical outlets, equipment, wireways and apparatus shall be furnished and installed and located in such a manner as to avoid conflict with equipment and materials installed under other sections of these specifications, preserving headroom and clearances and keeping openings and passageways clear.
 2. All contract drawings shall be examined by the Contractor to verify that work can be installed without conflict. Any deviations from the plans and specifications found to be required shall be reported to and approved by the Engineer before installing the work.
- O. Coordination with other trades:
1. The plans indicate the approximate location of outlets and materials unless dimensions are shown. Use proper judgment in locating outlets and materials to avoid conflict with work being installed by other trades.
 2. Outlets for connection to equipment shall be properly located by referring to shop drawings, manufacturers' recommendations, and/or by measuring actual equipment to be installed. Maintain close coordination with the mechanical equipment contractor, particularly as to quantity, location, size and arrangement of the various pieces of equipment.
 3. Examine all contract plans in order to logically locate work in coordination with construction such as cabinets, beams, furring, door swings, ducts, pipes and ceilings.
 4. Sleeves for electrical conduit passing through wall or slabs shall be placed before concrete is poured. Where conduit passes through suspended floor slabs, outside of chases, sleeves shall be either plastic or steel and be appropriately sealed. Sleeves at other locations shall be either lightweight galvanized steel tube, or galvanized sheet steel, with a minimum thickness of 24 USSG. Clearance between conduit and sleeves shall be not less than 1/2 inch. Sleeves through outside walls below grade shall be caulked tight.
 5. Where conflicts exist, make adjustments in the installation of the outlets and equipment to avoid interferences.
- P. Drawings and Specifications coordination:
1. For purposes of clearness and legibility, the electrical Drawings are essentially diagrammatic. The size and location of equipment is shown to scale whenever possible. The Contractor shall verify all conditions, data and information as indicated on the Drawings and in specifications sections where electrical work is required.

2. The electrical Drawings show the required size and points of termination of the conduits, the number and size of wires, and suggest the proper route for the conduit. It shall be the responsibility of the Contractor to install the conduits with minimum number of bends to conform to the structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and meet all applicable code requirements. The routing of conduits may be changed, if approved by the Engineer, provided that the length of any conduit run is not increased or decreased more than 10% of the length shown on the Drawings.
3. It is intended that outlets be located symmetrical with architectural elements notwithstanding the fact that locations shown on the Drawings may be distorted for clarity.
4. The architectural and structural Drawings take precedence over the electrical Drawings in the representation of the general construction work. The Drawings of the various trades take precedence in the representation of the work of those trades. The Contractor shall refer to all Drawings to coordinate the electrical work with the work of other trades.

Q. Terminology:

1. The term "signal system" shall apply to the fire alarm, annunciator, public telephone, and security systems.
2. The term "low voltage" shall apply to systems operating at 50 volts and under.
3. The term "provide" used on the Drawings and elsewhere in the Specifications shall be considered to mean "furnish and install".
4. The term "UL" means Underwriters Laboratories Inc.

R. Structural Considerations for Conduit Routing:

1. Where conduits are to pass through or will interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, to accommodate the electrical work, such work shall conform to State Building Code for conduits and pipes embedded in concrete and for notches and bored holes in wood; for steel, as detailed on the structural Drawings.
2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, the encasement shall, rest on a haunch integral with the wall or structure, or shall extend down to the footing projection, if any, or shall be doweled into the structures unless otherwise indicated. Underground structures shall include manholes, pull boxes, vaults and buildings.
3. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled and conduit nipple or coupling shall be provided.

S. Electrically Operated Equipment and Appliances:

1. Equipment and Appliances Furnished by the Contractor:
 - a. The electrical work shall include furnishing and installing wiring enclosures for, and the complete connection of all electrically operated equipment and appliances and any electrical control devices which are specified to be furnished and installed in this or other electrical sections of the Specifications, except electrical work specified or indicated to be in the Mechanical work. All wiring enclosures shall be installed concealed except where exposed work is indicated on the electrical Drawings.
 - b. Connections shall be made as necessary to completely install the equipment ready for use. The equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets of incorrect electrical characteristics or if any equipment fails to operate properly, the Contractor shall report to the Engineer in writing, the name, make and serial number of the equipment, and a description of the defect.
2. Equipment and Appliances Furnished by Others:
 - a. Equipment and appliances shown on the Drawings as N.I.C. (Not in Contract), "Furnished by Others" will be delivered to the Site. Required electrical connections shall be made for all such equipment and appliances in accordance with accepted

trade practices under the direction of the Electrical Inspector. All motorized equipment will be furnished factory wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.

- b. Connections to equipment furnished under other sections shall be part of the Electrical Work. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit and connections only for equipment furnished with factory installed internal wiring, except as further the Specifications. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push button stations, selector switches, conduit, junction boxes, and the wiring necessary for a complete electrical installation. The work shall also include furnishing and installing the conduit and outlet box, if needed for the control system, furnished under Mechanical. Devices and equipment furnished shall be of the same type used elsewhere on the job or as specified.
- c. Electrical equipment furnished under other Sections for installation and connection work under this Section shall be delivered to the installation location by the Contractor furnishing the equipment.
- d. Mechanical equipment furnished under other Sections and requiring electrical connection under this Section, will be set in place by Contractor furnishing the equipment.
- e. Suitability and condition of equipment furnished by other Sections shall be determined in advance of installation. Immediate notice shall be given to the Engineer of damage, unsuitability or lack of parts.

T. Protection of materials

- 1. Provide for the safety and good condition of all materials and equipment until final acceptance of the project by the Owner. Protect all materials and equipment from damage and provide adequate and proper storage facilities during the progress of the work. All damaged and defective work shall be replaced prior to final inspection.

U. Cleaning

- 1. Exposed parts of the electrical work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
- 2. Thoroughly clean all parts of the apparatus and equipment. Exposed parts which are to be painted shall be thoroughly cleaned of cement, plaster and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped and all corners and cracks scraped out. Exposed rough metal work shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
- 3. The Contractor shall place in bins provided by the General Contractor, all debris and rubbish caused by the electrical work. He shall thoroughly clean the building of dirt, debris, rubbish, marks, etc., caused by the performance of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be new and shall be listed by or bear the Underwriters' Laboratory label of approval, where subject to such approval and/or shall meet with the approval of the Division of Industrial Safety, State of California, and all governing bodies having jurisdiction there over; shall comply with ASA, IEEE and NEMA standards, where applicable, and shall meet with the approval of the Engineer.

- B. When materials are specified or described by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality, style, size, function and ratings, but items equivalent in all respects by other listed manufacturers will be accepted. Materials shall be furnished in ample quantities at the proper time. Refer to paragraphs "Equals", "Approvals" and "Plans and Specifications" in the General Conditions.
- C. Within forty five (45) days after issuance of IFC documents, the Contractor shall submit a list of proposed materials in quintuplicate giving manufacturer's name and catalog numbers or descriptive matter, including catalog cuts or brochures of lighting fixtures. For other shop drawings and data submittals see paragraphs "Shop Drawings" and "Equipment Data" of this section and Division 1, Section 01300.
- D. Sensitive electrical equipment shall not be installed until major construction is completed. During and after installation of this equipment, the equipment shall be protected from damage by water, dust, paint, wet concrete, plaster and mechanical injury.

END OF SECTION

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.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

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

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 - 6. Or Approved Equal
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
- D. Multiconductor Cable: Comply with NEMA WC 70 for mineral-insulated, metal-sheathed cable, Type MI nonmetallic-sheathed cable, Type NM Type SO and Type USE with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 - 6. Or Approved Equal
- 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. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for smaller than No. 10 AWG; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.

- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: 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. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or MC cable as allowed by code.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 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 Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "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.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches 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 Division 26 Section "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 Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test 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.
- C. 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.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Provide and install a grounding system as specified and indicated.
 - 2. Electrolytic Earth Grounding Installation
 - 3. Testing Procedures
- B. Related Work:
 - 1. See related sections for their system grounding requirements.
 - 2. Section 16010: Basic Electrical Requirements.

1.2 SYSTEM REQUIREMENT

- A. Grounding shall be as approved by the State of California, Division of Industrial Safety.
- B. Electrical continuity to ground metal raceways and enclosures, isolated from the equipment ground by use of non-metallic conduit or fittings, shall be provided by a green insulated grounding conductor of approved size within each raceway connected to the isolated metallic raceways, or enclosures at each end. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of approved size.
- C. Cold water or other utility piping systems can be used as grounding electrodes. All grounding electrodes shall be "made electrodes" specified as follows:
 - 1. Grounding electrodes as specified in Part 2 Paragraph 2.01 B of this specification.
 - 2. Concrete enclosed electrode, which is made up of at least 20 feet of #4 AWG copper conductor, encased by at least 2 inches of concrete, located within or near the bottom of a concrete foundation, or footing, which is in direct contact with the earth.
 - 3. Non-current-carrying metal parts of all high voltage equipment enclosure, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively grounded.
- D. Metallic or semi-conducting shields, and lead sheaths of all cables operating at high voltage, shall be permanently and effectively grounded at each splice and termination.
- E. The neutral of service conductors shall be grounded as follows:
 - 1. The neutral shall be grounded at only one point within the site for that particular service. Preferable location of the grounding point shall be at the service switchboard, or main switch.
 - 2. The equipment and conduit grounding conductors shall be bonded to that grounding point.
 - 3. If other buildings on the site are served from a switchboard or panelboard in another building, the power supply is classified as a feeder and not as a service.

4. The equipment grounding conductor is carried from the switchboard to each individual building. At the building, the grounding conductor is bonded with the power equipment enclosures, metal frames of building, etc., to the "made electrode" for that building.
 5. The neutral of the feeder shall not be grounded.
- F. If there is a distribution transformer at a building, the secondary neutral conductor shall be grounded to the "made electrode" serving the building.

1.3 SUBMITTALS

- A. Submit a material list in accordance with Section 01340: Submittals.

PART 2 - PRODUCT

2.1 GENERAL

- A. Yard boxes shall be precast concrete and shall be approximately 14" wide, 19" long, and 12" deep (outside dimensions), or larger, if necessary to obtain the required clearances. Boxes shall be equipped with bolt-down, checkered, cast iron covers and a cast iron frame cast into the box when subject to vehicular traffic. Yard boxes shall be Brooks 36 or approved equal. Use plastic boxes when in planters.
- B. "Made" electrodes shall be approved copper-clad steel ground rods, minimum 3/4" diameter, 10'-0" long.
- C. Self-contained ground rod(s) using electrolytically enhanced grounding shall be provided where specifically indicated on the drawings.
- D. Ground rod system shall be U.L. listed and manufactured for ten years or more.
- E. Ground rod system shall be 100% self-activating/sealed and maintenance free. No additions of chemical or water solutions required.
- F. To achieve specific earth resistance, contact manufacturer for engineering and applications support, 1-800-962-2610.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches 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.

2.3 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 exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.4 GROUND ACCESS BOX

A. Precast concrete box with slots for conduit entrances. Minimum size ten inch diameter by twelve inches high. Cast iron grate flush cover with "breather" slots, XIT model XB-12C-OR-

B. Fibrelyte box for non-traffic applications. Includes bolt down flush cover with "breather" holes, XIT model XB-12F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grounding electrodes shall be located in the nearest usable planting area, where not otherwise indicated on the Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, concrete yard box shall be 2" above planting surfaces.

1. The grounding electrode may be installed in the power distribution underground hand-hole, if that hand-hole is no more than 20 feet from the building being served.

B. If the concrete enclosed electrode is used, the grounding wire shall terminate to a suitable copper plate with grounding lugs.

C. Grounding rods shall be driven to a depth of not less than 8'-0".

D. Grounding electrodes shall have a resistance to ground of not more than 5 ohms.

E. When using grounding rods, if the resistance to ground exceeds 5 ohms, two or more rods connected in parallel shall be provided to meet the grounding resistance requirement.

- F. The minimum number of ground rods shall be as required by state electrical safety orders.
- G. Ground rods shall be separated from one another by not less than 6'-0"
- H. Parallel grounding rods shall be connected together with approved fittings and approved grounding conductors in PVC conduit, buried not less than 30" below finish grade.

3.2 EXCAVATION

- A. Remove sealing tape from leaching holes in the horizontal section only.

3.3 BACKFILL

- A. Place protective box so top is flush with grade level. Finish backfilling trench with soil. Use backfill or grout to stabilize box around rod.
- B. Remove sealing tape from top breather holes to activate.

3.4 CONNECTION

- A. Connect grounding electrode conductor(s) to ground rod pigtail exothermically (Cadweld or Thermoweld).
- B. Bury grounding conductor 30" below grade. Cover bare conductor with a small amount of backfill for protection against corrosion.

3.5 TESTING

- A. Certified measurements to be taken and submitted prior to connection to main service utility ground. Ground grid resistance shall not exceed 5 ohms.
- B. Upon completion of the ground installation and before connection to the permanent facility power, the electrical contractor shall provide at his expense, a measurement of the new earth grounding electrode system. The testing shall utilize an earth resistance meter and be conducted in accordance with the IEEE Standard 3-point fall of potential method.
- C. Notify the Owner's representatives three days prior to the scheduled testing date so they may be present at the time of testing.
- D. The grounding system shall pass a "Sixty two Percent Fall-of-Potential" test. The minimum length of the test conductors shall be 300 feet. Contractor shall have a curve of resistance vs. distance prepared. The contractor shall immediately notify the Owner's representative if the measured resistance is above 5 ohms.
- E. An independent testing firm or the manufacturer shall be employed for the testing and report. The contractor shall submit a copy of test report to the Owner's representative within 10 days after testing and before the ground system becomes inaccessible.

- F. The grounding resistance shall be tested and provide test reports to the City Electrical Inspector, Consulting Electrical Engineer and the City Electrical Engineer. The test results shall be submitted to the Electrical Technical Supervisor, on an official form, for file, with copies distributed to the Electrical Inspector and Electrical Engineer.

END OF SECTION

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. Division 26 Section "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. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by the manufacturer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. 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:

ICTC Callexico Intermodal Transit Center HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

IFB Deliverable

26 05 29 - 1
02/01/24

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

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:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 - h. Or approved equal
 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.

- c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
- 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where 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:
 - b. Manufacturers: Subject to compliance with requirements and codes, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 5) Inbedment type Blue Banger Hanger
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 - 6) Or approved equal
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.

7. 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 Division 05 Section "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 in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with one or two-piece conduit clamps based on application.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 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.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that 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 Division 05 Section "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. 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.

END OF SECTION

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. Nonmetal wireways and auxiliary gutters.
 5. Surface raceways.
 6. Boxes, enclosures, and cabinets.
 7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. 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. 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. 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.
 13. Or approved equal.
- 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. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: die cast or steel
 - b. Type: compression screw per application.
 2. 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.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, 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.
 13. Or approved equal.
- 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, EPC-80, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.
- L. 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).
- M. 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.
 5. Or approved equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R 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: Flanged-and-gasketed, or screw cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC 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. Allied Moulded Products, Inc.
 2. Hoffman; a Pentair company.
 3. Lamson & Sessions; Carlon Electrical Products.
 4. Niedax-Kleinhuis USA, Inc.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. 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."

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 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. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.

2.6 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.
 - 18. Or approved equal.
- 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. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb. shall be listed and marked for the maximum allowable weight.

- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- K. Gangable boxes are prohibited.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
 - 1. NEMA 250, Type 3R Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Provide NEMA 1 for interior locations.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Metal barriers to separate wiring of different systems and voltage.
 - 4. Accessory feet where required for freestanding equipment.
 - 5. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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.
 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of reinforced concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Nordic Fiberglass, Inc.
 - f. Oldcastle Precast, Inc.; Christy Concrete Products.
 - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
 2. Standard: Comply with SCTE 77.
 3. Color of Frame and Cover: Gray.
 4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 7. Cover Legend: Molded lettering, "ELECTRIC."
 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 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: RNC, Type EPC-80-PVC for utility pole riser only, GRC for other locations.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type Schedule 40 PVC, concrete encased where required by code and/or serving utility.
 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 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage above 7.5 feet: EMT.
 2. Exposed, Not Subject to Severe Physical Damage above 7.5 feet: EMT.
 3. Exposed and Subject to Severe Physical Damage and below 7.5 feet: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Drive isles.
 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 below 7.5 feet: GRC. (Except in electrical room where controlled access is provided, EMT may be provided).
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10. Die Cast or set screw per application.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

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 NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Division 26 Section "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 per NEC.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. A. Support conduit within 12 inches, for flexible conduit and 36" for conduit, of enclosures to which attached.
- I. Raceways Embedded in Slabs at ground floor only:
 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings or approved alternative.
 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC before rising above floor.
- 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 trade size and insulated throat metal bushings on 1-1/2-inch 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 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 tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. 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.
- U. 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.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet or approved alternate method per NEC.
 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 temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F 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 of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings or flexible joint by the use of flexible conduit and 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.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit or MC cable for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. 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.
 - Z. 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.
 - AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - BB. Locate boxes so that cover or plate will not span different building finishes.
 - CC. 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.
 - DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - EE. Set metal floor boxes level and flush with finished floor surface.
 - FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill with 2 sac slurry for non-utility runs. Once encased, utilize native backfill materials.
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through 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. Schedule 40 is acceptable when stubbed into switchgear, where not subject to physical damage.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment as required by NEC.
 - c. For Busway posts and all other equipment where the conduit is not exposed, provide a ground wire.

6. Underground Warning Tape: Comply with requirements in Division 26 Section "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 sieve to No. 4 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 above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "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 Division 07 Section "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

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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 for raceway and cable penetration of fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For sealants, 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."

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- C. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- D. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- E. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - f. Link Seal
 - g. Approved Equal
 - 2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Presealed Systems.
 - b. Link Seal
 - c. Approved Equal

2.4 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

ICTC Calexico Intermodal Transit Center

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant 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."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. 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 different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
 - 6. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 7. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

ICTC Calexico Intermodal Transit Center

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls raceway entries into building.
- B. Install 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.

3.3 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.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes the requirements of the following work necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Electrical equipment nameplates
 - 2. Panelboard directories
 - 3. Wire and cable identification
 - 4. Buried electrical line warning
 - 5. Junction box identification
 - 6. Warning and caution signs
 - 7. Engraved device cover plates
 - 8. Single Line Diagram
- B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 SUBMITTALS

- A. Product Data: Submittals shall consist of the following:
 - 1. Data/catalog cuts for each product and component specified herein.
 - 2. Submit a nameplate schedule for review before the nameplates are installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Conduit and wire markers: Manufactured by Thomas & Betts, Brady or equal.
- B. Inscription Tape: Manufactured by Kroy, Merlin or equal.

2.2 NAMEPLATES

- A. Type NP: Engraved, plastic laminated labels, Signs, and Instruction Plates.
 - 1. Engrave stock melamine plastic laminate 1/16-inch minimum thickness for signs up to 8 inches in length, 1/8 inch thick for larger sizes.
 - 2. Engraved nameplates shall be punched for mechanical fasteners.
- B. Color and letter height as specified in Part 3: Execution.

2.3 PANELBOARD DIRECTORIES

ICTC Calexico Intermodal Transit Center

IFB Deliverable

ELECTRICAL IDENTIFICATION

26 05 53 - 1

02/01/24

- A. Directories: A 6 inch x 8 inch minimum size circuit directory frame and card with clear plastic covering shall be provided inside the inner panel door.
- B. Circuit numbering: Starting at the top, odd numbered circuits in sequence down the left hand side and even numbered circuits down the right hand side.

2.4 WIRE AND TERMINAL MARKERS

- A. Provide self-adhering, pre-printed, machine printable or write-on, self-laminating vinyl wrap around strips. Blank markers shall be inscribed using the printer or pen recommended by manufacturer for this purpose.

2.5 CONDUCTOR PHASE MARKERS

- A. Colored vinyl plastic electrical tape, 3/4" wide, for identification of phase conductors. Scotch 35 Brand Tape, Manville or equal.

2.6 UNDERGROUND CONDUIT MARKER

- A. Provide 6-inch wide with a minimum 4mil thickness, yellow polyethylene tape, resistant to acids and alkalines, with continuous black imprinting reading "Caution - Buried Electric Line Below".

2.7 INSCRIPTION TAPE LABELING

- A. Coverplate material shall be as specified in Section 26 2726: Wiring Devices.
- B. Provide self-adhesive labeling tape:
 - 1. 1/8" high letters
 - 2. Clear tape with Black lettering for normal power, Red for emergency.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of identification device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 NAMEPLATES

- A. Installation:
 - 1. Degrease and clean surfaces to receive nameplates.
 - 2. Install nameplates parallel to equipment lines.
 - 3. Secure nameplates to equipment fronts using machine screws.
- B. Provide type 'NP' color coded nameplates that present, as applicable, the following information:
 - 1. Equipment or device designation
 - 2. Amperage, KVA or horsepower rating, where applicable

3. Voltage or signal system name
 4. Source of power or control
 5. Typical examples:
 - a. Switchboards: SB2a/s; 2500A; 277/480V
 - b. Transformers: T2/A; 480V -120/208V; from HD2/A
 - c. Panelboards: H2b/A; 277/480V; from HD2/A
 - d. Disconnects: "AH-1; 25HP/480V; from HD2/B
- C. Nameplates for normal power system distribution equipment and devices shall be white w/black lettering.
 - D. Nameplates for emergency power system distribution equipment and devices shall be red w/white lettering.
 - E. Nameplates for signal systems equipment and devices shall be white w/black lettering.
 - F. Nameplates for Fire Alarm systems equipment and devices shall be red w/white lettering.
 - G. Minimum letter height shall be as follows:
 1. For switchboards, panelboards, switchboards, transformers, motor control centers etc.: ½ inch letters to identify equipment designation. Use ¼ inch letters to identify the remaining items.
 2. For individual circuit breakers, disconnect switches and motor starters in switchboards and motor control centers use 3/8-inch letters to identify equipment designation. Use 1/8 inch letters to identify the remaining items.
 3. For individual mounted circuit breakers, disconnect switches, enclosed switches and motor starters use 3/8-inch letters to identify equipment designation. Use 1/8-inch letters to identify the remaining items.
 4. For transformers use ½ inch letters to identify equipment designation. Use ¼ inch letters to identify the remaining items.
 5. For equipment cabinets, terminal cabinets, control panels and other cabinet enclosed apparatus use ¼ inch letters to identify equipment designation.

3.3 PANELBOARD DIRECTORIES

- A. Provide typewritten directories arranged in numerical order denoting loads served by room number or area for each circuit.
- B. Verify room numbers or area designation with Owner. Final room numbers may not be the same as on the plans.
- C. Mount panelboard directories in a metal frame under clear plastic cover inside every panelboard.

3.4 WIRE AND CABLE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboards, pull boxes, outlet and junction boxes and at load connection. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- B. Provide colored phase markers for conductors as noted in Section 26 0519: Wire and Cable. Apply colored, pressure sensitive plastic tape in half-lapped turns for a distance of 3 inches from

terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Do not cover cable identification markings by taping.

3.5 UNDERGROUND CONDUIT MARKERS

- A. During trench backfilling, for exterior underground power, signal, and communications ductbank/conduits, install continuous underground plastic line marker located directly above ductbank/conduits at 10 to 18 inches below finished grade. Where multiple conduits installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single marker.

3.6 JUNCTION BOX IDENTIFICATION

- A. The cover of junction, pull, and connection boxes for lighting, power and signal systems, located above suspended ceilings and below ceilings in non-public areas, shall be clearly marked with a permanent ink felt pen. Identify the circuit(s) (panel designation and circuit numbers) contained in each box, unless otherwise noted or specified.

3.7 WARNING, CAUTION AND INSTRUCTION SIGNS

- A. Provide warning, caution, or instruction signs where required by CEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
- B. Emergency Operating Signs: Install engraved laminate signs with white letters on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- C. Warning signs to be included on doors or immediately above doors of all electrical rooms, vaults or closets containing equipment energized above 150 volts to ground. The sign shall state "DANGER - HIGH VOLTAGE", with "DANGER" in 1-1/2" letters and "HIGH VOLTAGE" in 1 inch letters.

3.8 INSTALLATION

- A. Nameplates shall be mounted with steel screws.
- B. Signs shall be permanently mounted with steel screws.
- C. Provide a full size laminated photocopy of single line diagram on wall of Electrical/IT Rooms.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For coordination-study specialist.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Switchgear and switchboard bus.
 2. Medium-voltage controller.
 3. Motor-control center.
 4. Distribution panelboard.
 5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- and high-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.

- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL 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. Time switches.
 - 2. Photoelectric switches.
 - 3. Standalone daylight-harvesting switching controls.
 - 4. Indoor occupancy sensors.
 - 5. Outdoor motion sensors.
 - 6. Lighting contactors.
 - 7. Emergency shunt relays.
- B. Related Requirements:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. 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 each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Invensys Controls.
 4. Leviton Mfg. Company Inc.
 5. NSi Industries LLC; TORK Products.
 6. Tyco Electronics; ALR Brand.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: DPST.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 6. Programs: 6 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
 7. Programs: 12 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule with a skip-a-day weekly schedule.
 8. Programs: 12 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
 9. Programs: 24 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
 10. Programs: 24 channels; each channel is individually programmable with 40 on-off operations per week, plus four seasonal schedules that modify the basic program, and an annual holiday schedule that overrides the weekly operation on holidays.
 11. Programs: 24 and an annual holiday schedule that overrides the weekly operation on holidays.
 12. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 13. Astronomic Time: All channels.
 14. Automatic daylight savings time changeover.
 15. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.
- C. Electromechanical-Dial Time Switches: Comply with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: DPST.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
 5. Astronomic time dial.
 6. Eight-Day Program: Uniquely programmable for each weekday and holidays.
 7. Skip-a-day mode.

8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. NSi Industries LLC; TORK Products.
 4. Tyco Electronics; ALR Brand.

- B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 3. Time Delay: Fifteen second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

- C. Description: Solid state, with DPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Thirty-second minimum, to prevent false operation.
 4. Lightning Arrester: Air-gap type.
 5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Cooper Industries, Inc.
 2. Eaton Corporation.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 6. NSi Industries LLC; TORK Products.
 7. Sensor Switch, Inc.
 8. Tyco Electronics; ALR Brand.
 9. Watt Stopper.
 10. Lutron.

- B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack mounted on luminaire, to detect changes in indoor lighting levels that are perceived by the eye.
- C. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
 - 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
 - 9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
 - 10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
 - 11. Control Load Status: User selectable to confirm that load wiring is correct.
 - 12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Cooper Industries, Inc.
 - 2. Hubbell Building Automation, Inc.
 - 3. Leviton Mfg. Company Inc.
 - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 5. Watt Stopper.
 - 6. Lutron.
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
 - 1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 - 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
 - 3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
 - 4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

2.5 INDOOR OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC; TORK Products.
 9. RAB Lighting.
 10. Sensor Switch, Inc.
 11. Square D; a brand of Schneider Electric.
 12. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC; TORK Products.
 9. RAB Lighting.
 10. Sensor Switch, Inc.
 11. Square D; a brand of Schneider Electric.
 12. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor Tag WS1:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 4. Voltage: Match the circuit voltage; dual-technology type.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

- D. Wall-Switch Sensor Tag WS2:
1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
 2. Sensing Technology: PIR.
 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 4. Voltage: Match the circuit voltage; dual-technology type.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.7 OUTDOOR MOTION SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 6. NSi Industries LLC; TORK Products.
 7. RAB Lighting.
 8. Sensor Switch, Inc.
 9. Watt Stopper.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Dual-technology (PIR and infrared) type, weatherproof. Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. Comply with UL 773A.
 3. Switch Rating:
 - a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent.
 - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 4. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off." With bypass switch to override the "on" function in case of sensor failure.
 5. Voltage: Match the circuit voltage type.
 6. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
 - b. Long Range: 180-degree field of view and 110-foot detection range.
 7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 9. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
 11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.8 LIGHTING CONTACTORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Eaton Corporation.
 - 4. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
 - 5. Square D; a brand of Schneider Electric.

- B. Description: Electrically operated and mechanically held, combination-type lighting contactors with non-fused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
 - 1. Monitoring: On-off status.
 - 2. Control: On-off operation.

2.9 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

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 lighting controls with relays and control module.
- B. Section includes manually operated, PC-based, digital lighting controls with external signal source, relays and control module.
- C. Related Sections:
 - 1. Division 26 Section "Lighting Control Devices" for time clocks, photoelectric sensors, occupancy sensors, and multipole 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, DALI network materials, 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 BAS. Design display graphics showing building areas controlled; include the status of lighting controls in each area.
 - 3. 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 Division 26 Section "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: 1 year from date of Substantial Completion.
 - 3. Extended Warranty Period Failure Due to Transient Voltage Surges: 2 years.
 - 4. Extended Warranty Period for Electrically Held Relays: 2 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, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide LC &D, GR2432 ENC SMNEI (enclosure) and GR2432INT-24DTCMOD-DV-2VB (interior), or comparable product by one of 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. Musco Lighting.
 8. NexLight; part of the Northport Engineering Group.
 9. Square D; a brand of Schneider Electric.
 10. Starfield Controls, Inc.
 11. Touch-Plate Technologies.
 12. Triatek, Inc.
 13. Watt Stopper/Legrand.
 14. Douglas.

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 switch operation sends a signal to 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 to groups of lighting fixtures or other loads.
- C. 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.
- D. Performance Requirements: Individually addressable devices (such as electronic ballasts, dimmers, and manual switches) are operated from digital signals received through a DALI-compliant bus, from data-entry and -retrieval devices (such as PCs, personal digital assistants (PDAs), hand-held infrared programming devices, wired Ethernet hubs, wireless IEEE 802.11 hubs. Devices also report status to data-entry and -retrieval devices through the bus.

- E. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status.
 - b. Control: On-off operation
 - 2. Industry-accepted, open-protocol communication interface with the BAS shall enable the BAS operator to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

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.
- B. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state, 365-day timing and control unit. Unit shall be networked for control of indicated number of output circuits. 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, all located in other enclosures. 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 shall display manual-control and programming steps. Modules and their associated control panels shall include the following features:
 - 1. Multichannel output with 2 channels.
 - 2. Multiple inputs and multichannel output arranged for 2 channels.
 - 3. Multiple inputs for indicated occupancy sensors and hand-held programming device.
- C. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state, 365-day timing and control unit. Control units shall be networked and capable of receiving inputs from indicated sensors and hand-held programmer. Output circuits shall be pilot-duty relays compatible with power switching devices. Output circuits shall include digital circuits arranged to transmit control commands to remote preset dimmers. Modules and their associated control panels shall include the following features:
 - 1. Multichannel output with 2 channels.
 - 2. Multiple inputs and multichannel output arranged for 2 channels.
 - 3. Multiple inputs for occupancy sensors, daylight sensors, and dimming systems with associated daylight sensors.
- D. Control Module Description: Panelboard mounted; comply with UL 916 (CSA C22.2, No. 205); microprocessor based, solid-state, 365-day timing and control unit. Control units shall be networked and capable of receiving inputs from sensors and other sources. Panelboard shall use low-voltage-controlled, electrically operated, molded-case branch circuit breakers as prime power-circuit switching devices. Circuit breakers and a limited number of digital or analog, low-voltage control-circuit outputs shall be individually controlled by control module. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable. Panelboard shall also comply with Division 26 Section "Panelboards."

- E. Control Module Description: Comply with UL 508 (CAN/CSA C22.2, No. 14); microprocessor-based, networked, control unit; mounted in preassembled, modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units shall be capable of receiving inputs from sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable.
- F. Control Module Description: Programmable, PC-based unit with 15-inch color LCD and keyboard for graphic display and programming of system status and to override breaker status; and to display status of local override controls and diagnostic information. If the control module is applied to emergency lighting units, control unit shall indicate failure of normal power and that the lighting units are, or are not, powered by the alternate power source.
1. Display: Single graphic display for programming lighting control panelboards.
 2. Display: Separate graphic displays for programming each lighting control panelboard.
 3. Interoperability: Control module shall be configured to connect with other control systems using RS-485 network to enable remote workstations to use control module functions.
 4. Interoperability: Control module shall be configured to connect to BacNet-compliant network, resulting in extending control to any network-compliant devices such as occupancy switches.
 5. Interoperability: Lighting control shall be configured to allow individual users to turn lighting on and off with their PCs. Software shall be written for Windows operating system, with Web page as the display and ActiveX controls that can be accessed through an Internet browser. Include at least three levels of password protection. Include an egress lighting option that will provide each user with a lighted path for exiting the building after normal working hours.
 6. System Memory: Nonvolatile. System shall reboot program and reset time automatically without errors after power outages up to 90 days' duration.
 7. Software: Lighting control software shall be capable of linking switch inputs to relay outputs, retrieving links, viewing relay output status, controlling relay outputs, simulating switch inputs, setting device addresses, and assigning switch input and relay output modes.
 8. Automatic Time Adjustment: System shall automatically adjust for leap year and day light saving time and shall provide weekly routine and annual holiday scheduling.
 9. Astronomic Control: Automatic adjustment of dawn and dusk switching.
 10. Demand Control: Demand shall be monitored through pulses from a remote meter and shall be controlled by programmed switching of loads. System capability shall include sliding window averaging and programming of load priorities and characteristics. Minimum of two different time-of-day demand schedules shall execute load-management control actions by switching output circuits or by transmitting other types of load-control signals.
 11. Confirmation: Each relay or contactor device operated by system shall have auxiliary contacts that provide a confirmation signal to the system of on or off status of device. On or off status confirmation for each electrically operated circuit breaker shall be provided by an auxiliary contact or by a sensing device at load terminal.
 - a. Software shall interpret status signals, provide for their display, and initiate failure signals.
 - b. Lamp or LED at control module or display panel shall identify status of each controlled circuit.
 12. Remote Communication Capability: Allow programming, data-gathering interrogation, status display, and controlled command override from a PC at a remote location over data links. System shall include modem, communications and control software, and remote computer compatibility verification for this purpose.

13. Telephone Override Capability: Override programmed lighting shutdown commands by telephoning computer and entering a voice-menu-guided, override touch-tone code specific to zone being controlled.
14. Local Override Capability: Manual, low-voltage control devices shall override programmed shutdown of lighting and shall override other programmed control for intervals that may be duration programmed.
15. Automatic Control of Local Override: Automatic control shall switch lighting off if lighting has been switched on by local override. Comply with provisions in California Code of Regulations, Title 24, Part 6.
16. Automatic battery backup shall provide power to maintain program and system clock operation for 90 days' minimum duration when power is off.
17. Programmed time signals shall change preset scenes and dimmer settings.
18. Daylight Balancing Dimming Control: Control module shall interpret variable analog signal from photoelectric sensor and shall route dimming signals to dimming fluorescent ballast control circuits. Signal shall control dimming of fixture so illumination level remains constant as daylight contribution varies.
19. Daylight Compensating Switch Control: Control module shall interpret a preset threshold illumination-level signal from a photoelectric relay and shall activate relays controlling power to selected groups of lighting fixtures to turn them on and off to maintain adjustable minimum illumination level as daylight contribution varies.
20. Energy Conservation: Bilevel control of special ballasts or dimming circuits to comply with local energy codes.
21. Flick Warning: Programmable momentary turnoff of lights shall warn that programmed shutoff will occur after a preset interval. Warning shall be repeated after a second preset interval before end of programmed override period.
22. Diagnostics: When system operates improperly, software shall initiate factory-programmed diagnosis of failure and display messages identifying problem and possible causes.
23. Additional Programming: In addition to system programming by the PC, individual control modules shall be networked and programmable using data-entry and -retrieval (such as PCs, personal digital assistants (PDAs), hand-held infrared programming devices, wired Ethernet hubs, wireless IEEE 802.11 hubs).

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. Electrically Operated, Molded-Case Circuit-Breaker Panelboard: Comply with NEMA PB 1 and UL 50 (CAN/CSA C22.2, No. 94), UL 67 (CSA C22.2, No. 29), UL 489 (CAN/CSA C22.2, No. 65), and UL 916 (CSA C22.2, No. 205).

1. Cabinets: In addition to requirements specified below, comply with Division 26 Section "Panelboards."
 2. Electrically Operated, Molded-Case Circuit Breakers: Bolt-on type.
 - a. Switching Endurance Ratings: Certified by manufacturer or by a nationally recognized testing laboratory (NRTL) for at least 20,000 open and close operations under rated load at 0.8 power factor.
 - b. Minimum 30,000 open and close operations with load equal to circuit-breaker trip rating and consisting of 100 percent tungsten filament load.
 - c. Minimum 30,000 open and close operations with load equal to circuit-breaker trip rating and consisting of 100 percent fluorescent ballasts rated for 10 percent total harmonic distortion.
 - d. Listed and labeled as complying with UL SWD, HCAR, and HID ratings by an NRTL acceptable to authorities having jurisdiction.
- C. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels.
- D. Line-Voltage Surge Suppression: Field-mounting surge suppressors that comply with Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for Category A locations.
- E. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels or field-mounting surge suppressors that comply with Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for Category A locations.

2.5 MANUAL ANALOG SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary-contact, low-voltage type.
 1. Match color specified in Division 26 Section "Wiring Devices."
 2. Integral green LED pilot light to indicate when circuit is on.
 3. Internal white LED locator light to illuminate when circuit is off.
- B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Division 26 Section "Wiring Devices."
- C. Wall-Box Dimmers: Comply with Division 26 Section "Wiring Devices."
- D. Wall Plates: Single and multigang plates as specified in Division 26 Section "Wiring Devices."
- E. 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 6 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 Division 26 Section "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 Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Structured Network Digital and Multiplexed Signal Cables: UTP cable with copper conductors, complying with TIA/EIA-568-B.2, Category 6 for horizontal copper cable and with Division 27 Section "Communications Horizontal Cabling."
- E. RS-485 Cables:
 - 1. Standard Cable: NFPA 70, Type CM.
 - 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 1/2 inch.
 - 1. For power wiring comply with Division 26 Section "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 Division 26 Section "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 Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: 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 and software training for PC-based control systems. See Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Furnish, install and connect the main switchboard, including metering facilities as required by the power company.
 - 2. All main switchboards shall be complete with pull, service and distribution sections.
 - 3. All protective devices in main switchboard shall have a minimum symmetrical short circuit interrupting rating, as provided by the electric utility company.
 - 4. Provide mounting detail and/or seismic anchorage notes on all switchboards.

1.2 SUBMITTALS

- A. All submittals shall be made in accordance with Division 1, SUBMITTAL PROCEDURES.
- B. Shop Drawings:
 - 1. Include a front elevation showing the dimensions and the locations of the equipment on the switchboard, the make, kind and size or capacity of all equipment and bussing, the location of each service conduit entering the switchboard, all barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.
 - 2. Coordination Curves shall be provided by the manufacturer for main circuit breaker and all distribution circuit breakers. Protective device coordination study and arc-flash calculation shall be provided by equipment manufacturer.
- C. Record Drawings:
 - 1. Provide a single reproducible drawing of the switchboards as installed, showing main and branch circuit ratings and circuit numbers.

1.3 QUALITY ASSURANCE

- A. All work shall be done by a qualified contractor holding C-10 and all other licenses and permits required by the legally constituted authorities having jurisdiction over the work.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. General Description: Switchboards shall be the products of Square D Company, Cutler Hammer, Sylvania, Westinghouse, GE and Seimens and shall conform to the following requirements:

1. The complete assembly, including steel framing and covers, the bus system, and the switch mounting, shall satisfy all applicable provisions of UL 891 and NEMA PB-2 for low voltage distribution switchboards.
2. All switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, fused switch type, unless otherwise indicated and shall contain the equipment indicated and specified. Switchboard shall be complete with pull, service and distribution sections.
3. The required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets all welded together in such a manner that the cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with all assembly holes die-stamped or jig drilled; openings for inter-connections shall be so placed that any cabinet can be located in any position in the assembly without drilling or cutting holes on the job. Deliver the switchboard to the site in completely assembled sections and provide all required assembly bolts and blanking plates. The front plates and doors shall be die-formed steel, of not less than #12 gage furniture steel, completely removable, secured to the cabinet with oval head machine screws, with cup washers, and uniformly and symmetrically spaced.
4. Circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic type bolted to the position. Breakers shall have a single handle with no tie-bar. Voltage, amperage and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle. Breakers shall have lock-out provisions approved by the state for padlocking and shall have a minimum symmetrical short circuit interrupting rating, as shown on the drawings.
5. The meter panel or plate shall meet all requirements of the serving Utility and be equipped with the necessary fittings.
6. Provide copper bus bars of same capacity as main breaker, or as indicated on the Drawings, between the current transformer and the main section and the distribution sections; also, the full length of the available breaker space in the distribution portions. Bus bar bracing shall be designed to withstand maximum available short circuit current. Provide service cable lugs as required by the utility company. Copper bus bars shall be rated at a minimum of 1000 amperes per square inch of cross-sectional area. Heat test rating on the bus bars is not acceptable in lieu of the required cross-sectional area.
7. Provide a nameplate for each component on the switchboard. Plates shall be black and white bakelite nameplate stock, with characters cut through the black exposing the white, and shall bear the designation of the service, or feeders controlled and the circuit breaker size.
8. Paint the cabinets, framework, and all plates inside and out with one coat of rust resisting metal primer and one coat of grey enamel, baked on, or lacquer sprayed on.
9. Manufacture the boards according to standardized drawings and specifications which are available for checking, and prepare shop drawings and submit for approval. The switchboard shall meet the requirements of all legally constituted authorities having jurisdiction, and the respective serving utility.

B. Building Main Switchboard:

1. Building main switchboard shall be of the floor standing metal clad dead-front type. Arrangement and construction shall be as indicated on the drawings and specified. Design, construction and testing shall comply with Code requirements and applicable ASA, AIEE and NEMA Standards. Structural elements of cubicles shall consist of standard rolled shapes or formed sheet steel members with a 12 gage minimum thickness. Construction shall be of the bolted or welded type with sufficient mechanical strength to maintain rigidity under shipping, erection, or short circuit stresses. Cubicles shall be insulated and enclosed with captive bolted P & O Mill prime or cold rolled sheet steel covers. End cubicles shall be provided with blanking plates for future additions. Switchboard shall not exceed 90" in height, including wiring gutters or pull spaces. All steelwork shall be sanded, cleaned, rustproofed and primed. Finish coating shall be

- factory standard. Construction marks or damaged surfaces shall be refinished at the job site to match original finish.
2. Buswork and connections shall be hard-drawn copper bars having a minimum conductivity of 98 percent. Current density for copper shall not exceed 1,000 amperes per square inch for connections. Continuous full load temperature rise shall not exceed NEMA requirements and those listed in applicable codes. Bus structure shall be free-fitted, and shall have sufficient strength and rigidity to withstand short circuits of the magnitude shown on the Drawings, without damage or permanent distortion. Connections shall be securely bolted together. Fastening bolts shall be non-magnetic corrosion-resistant plated steel or electrical bronze, secured with constant pressure-type locking devices. Insulating supports shall be made of high-strength, impact-resistant, flame-retardant material. Connections for incoming and outgoing cables shall be supplied with heavy duty pressure-type terminal lugs. Cables and internal wiring shall be supported with suitable bolted cleats. Arrangement of incoming and outgoing cables shall be as shown on the Drawings or as required. All insulated conductors used within the switchboard shall be listed, flame-retardant and shall be rated not less than the voltage applied to it, and not less than the voltage applied to other conductors or busbars with which switchboard may come into contact.
 3. Current transformer mounting facilities and metering mounting facilities shall be provided in accordance with utility company requirements.
 4. Main circuit breaker shall be molded case type, quick-make, quick-break, with thermal-magnetic trips, of frame size and trip rating indicated on Drawings. Main breaker shall have a minimum short circuit interrupting capacity as determined by the utility company. Provide ground fault sensing which shall be integral with the circuit breaker.
 5. Nameplates shall be furnished for each device. A large nameplate identifying the switchboard, showing service voltage, function and current rating shall be supplied. Test material information shall be taken from the Drawings and a format submitted for review together with the shop drawings. Nameplates may be made of engraved laminated plastic or etched metal and shall be permanently attached with escutcheon pins or screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Tightening of wire lugs or any wire/cable connections shall be performed in the presence of the City Electrical Inspector. The torque values to be those recommended by the manufacturer.

3.2 PADS AND ANCHORING

- A. Where freestanding equipment is installed at exterior locations or in basements, concrete pads shall be provided as described under Division 3: Concrete. Where a utility meter is housed in a switchboard, pad shall extend three feet from face of switchboard door or board, whichever is greater. Anchor bolts for free-standing equipment shall be designed to meet state seismic requirements. Equipment shall be anchored to new slab with 1/2" expansion bolts. All 1/2" anchored bolts shall be tested to withstand 50 ft-lbs. torque.

END OF SECTION

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.
 3. Load centers.
 4. Electronic-grade panelboards.

1.3 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 and the unit will be fully operational after the seismic event."

1.4 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. Include evidence of NRTL listing for series rating of installed devices.
 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 7. Include wiring diagrams for power, signal, and control wiring.
 8. 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. Protective device coordination study shall be provided by equipment manufacturer.

- C. Contractor to submit all required submittals per specification section 260573 "Overcurrent Protective Device Coordination Study" prior submitting product data for this specification section. Any discrepancy between the submitted product data and the equipments or devices used in coordination study will require the contractor to redo the protective device coordination study. Acceptance and approval of protective device coordination study by the engineer of record is a pre-requisite to submittal of product data for switchboards, panelboards and transformers.

1.5 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 Division 26 Section "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.

1.6 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 Division 01 Section "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.

1.7 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. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

- B. 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.
- 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. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407.

1.10 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 minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- 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 Architect Construction Manager and Owner no fewer than ten working 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.

1.11 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 in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and 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 12.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel and galvanized 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: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- 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.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 - 4. Split Bus: Vertical buses divided into individual vertical sections.
- 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.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical.
 - 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device, or Mechanical.
 - 6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Eaton Electrical Inc.
 2. Siemens Energy & Automation, Inc.
 3. 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 high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in 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.
- G. Branch Overcurrent Protective Devices: Fused switches.
- H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 120-V branch circuit.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Eaton Electrical Inc.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

- E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.
 - 2. Siemens Energy & Automation, Inc.
 - 3. 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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression 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. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

- g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
 - 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
 - 3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

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. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Mount top of trim maximum of 90 inches above finished floor unless otherwise indicated.
- E. 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.
- F. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- 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 Division 26 Section "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 Division 26 Section "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 Division 26 Section "Identification for Electrical Systems."

3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."
- C. 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.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of wiring devices.

1.2 RELATED WORK

- A. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets boxes.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.

1.4 SUBMITTALS

- A. In accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL, submit the following:
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70..... National Electrical Code (NEC)

- C. National Electrical Manufacturers Association (NEMA):
 - WD 1 General Color Requirements for Wiring Devices
 - WD 6 Wiring Devices – Dimensional Requirements
- D. Underwriter’s Laboratories, Inc. (UL):
 - 5 Surface Metal Raceways and Fittings
 - 20 General-Use Snap Switches
 - 231 Power Outlets
 - 467 Grounding and Bonding Equipment
 - 498 Attachment Plugs and Receptacles
 - 943 Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 Wall (Local) Switches:

- A. Totally enclosed, AC rated, silent type ivory finish or other finishes on dark colored walls as selected by the Owner. Switches on emergency circuits shall be red. All switch mounting straps shall be metal and offer self-grounding or be equipped with a green, hex-head ground screw. Numbers used below are those of Hubbell. Equivalent Leviton Arrow-Hart, Bryant, P & S, Sierra or G.E. are acceptable.
 - 1. Single-Pole Switches #1221-I 20 amps 277 volts
 - 2. Three-Way Switches #1223-I 20 amps 277 volts
 - 3. Four-Way Switches #1224-I 20 amps 277 volts
 - 4. Switch with Pilot Series 1200-PL
 - 5. Key Switch #1201-L 20 amps 277 volts
 - 6. Occupancy sensor switch shall be The Watt Stopper (c1-100 passive infrared sensor).

2.2 Receptacles:

- A. Duplex receptacles shall be specification grade, NEMA 5-15R or 5-20R configuration. They shall be capable of being side or back wired, with clamp type terminals for back wiring and have a metal mounting strap with self-grounding and a green, hex-head grounding termination screw. The grounding blades shall be aligned in such a manner that they are parallel to the longitudinal plane of the receptacle. Numbers used below are those of Hubbell. Equivalent Leviton, Arrow-Hart, Bryant, P&S, Sierra, or GE are acceptable.
 - 1. Duplex 15A #5262I
 - 2. Duplex 20A #5362I
 - 3. Duplex 15A-isolated ground #IG5262
 - 4. Duplex 20A-isolated ground #IG5362
 - 5. GFI Duplex 20A #GF5362I
- B. Receptacles shall be ivory finish, or other finishes on dark colored walls as selected by the Owner.
- C. Isolated ground receptacles shall be orange.

- D. Receptacles on emergency circuits shall be red, except for isolated ground receptacles on emergency circuits, which shall be orange with red cover plates.
- E. Provide flush combination data and/or telephone or single service floor boxes as required. Provide Hubbell B-2537 with standard receptacles as required. S-3925 covers for duplex receptacles and S-2725 for telephone.
- F. Device Cover Plates: shall stainless steels 602 stamped steel cover plates. Color of device plates shall be coordinated with the Owner. Red smooth nylon plates for receptacles on emergency circuits. Weatherproof: Cast aluminum double lift. Hubbell 5206WO.
- G. Telephone or Data Receptacles: 4" square box with one gang plaster ring. Provide blank cover plates on all unused outlets (50% of total number shown).
- H. Special Purpose Receptacles: Provide where shown on drawings. Specification grade, standard color, and of the appropriate code and NEMA configuration to match the supply circuit and load involved. Provide proper grounding through receptacle for equipment.

PART 3 - EXECUTION

3.1 WIRING DEVICES

- A. Install devices of type indicated on drawings. All connections shall be made up tight and device set plumb. Use care in installing device in order to prevent damage to device and wire in outlet box.
- B. Provide a device plate for each outlet to suit device installed and install blank plates or covers for conjunction boxes and empty outlets.

3.2 OUTLET BOXES, JUNCTION BOXES AND PULL BOXES

- A. Outlet Boxes: Hot-dipped galvanized or sherardized of required size, 4" sq. minimum or octagonal and of depth required for flush mounted devices and lighting fixtures. Cast-type with gasketed covers for surface-mounted devices. All outlets for exterior application shall be cast, weatherproof type with gasket and cast cover plate.
- B. Junction and Pull Boxes: Use outlet boxes as junction boxes wherever possible. Larger junction and pull boxes over 12" in any dimension shall be fabricated from sheet steel, sized according to code, and have screw-on covers. All junction boxes shall be accessible.

3.3 OUTLETS

- A. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all panels, equipment, etc. with the Engineer. If dimensions are not given, locate outlets within +6" of location as scaled from drawings.
- B. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4" octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8" no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted

with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide tile box or a 4" square box with tile ring in masonry walls which will not be plastered or furred, or where "drywall" type materials are applied.

- C. Back-to-back outlets in the same wall, or thru-wall type boxes not permitted. Provide 8" (minimum) long nipple to offset for all outlets shown on opposite sides of a common wall to minimize sound transmission.
- D. Surface-mounted devices are to be mounted in cast-type boxes with gasketed covers.
- E. Except as otherwise noted on architectural, locate outlets and panelboards as follows: Dimensions given are from finished floor to center line of outlets except panels. Adjust heights of outlets in masonry walls to correspond with consistent brick or block course. Outlets in block walls shall be installed in core of block.
 - 1. Wall switches 48"
 - 2. Convenience outlets, long axis vertical
with grounding pole on bottom 18"
 - 3. Phone outlets 18"
 - 4.....Panelboards (to top of trim) 6'-6"
 - 5. Wall-mounted shelf-type pay phone outlet 3'-4"
 - 6. Fire alarm horns 7'-6"
 - 7. Fire alarm stations..... 3'-8"
 - 8. Clock outlets..... 84"
 - 9. Data outlets 18"
 - 10. Wall phone outlets..... 54"
- F. Over counters, benches, special equipment, baseboards, fin tube radiators, etc. or at wainscoting, outlets shall be at a height (6") to prevent interferences to service equipment, or as noted on drawings.

END OF SECTION

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 enclosed controllers and motor-control centers.
 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches.
 3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
 4. Spare-fuse cabinets.

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 Division 01 Section "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.
- E. Comply with UL 248-11 for plug fuses.

1.6 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, 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, provide products by one of 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.

2.3 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuse-holders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

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. Service Entrance: Class RK1, time delay.
 - 2. Feeders: Class L, time delay.
 - 3. Motor Branch Circuits: Class RK5, time delay.
 - 4. Other Branch Circuits: Class RK5, time delay.
 - 5. Control Circuits: Class CC, fast acting.
- B. Plug Fuses:
 - 1. Motor Branch Circuits: Edison-base type, dual-element time delay.
 - 2. Other Branch Circuits: Edison-base type, dual-element time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuse-holders and sockets. Ensure that adapters are irremovable once installed.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "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

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. Non-fusible switches.
 3. Receptacle switches.
 4. Shunt trip switches.
 5. Molded-case circuit breakers (MCCBs).
 6. Molded-case switches.
 7. 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 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 Division 01 Section "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.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.8 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 and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- 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 Architect Construction Manager and Owner no fewer than 10 working Insert number 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.

1.9 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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 GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. 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.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 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.
- E. Type HD, Heavy Duty, Double 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.
- F. 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. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Compression type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.
 - 9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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 GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. 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.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 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.
- E. Type HD, Heavy Duty, Double 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.
- F. 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. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: Two 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: Compression type, suitable for number, size, and conductor material.
 - 7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 SHUNT TRIP SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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 red 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression 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. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts, "a" contacts mimic circuit-breaker contacts, and "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.5 MOLDED-CASE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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: Compression 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: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, and "b" contacts operate in reverse of switch contacts.
 7. Alarm Switch: One NO 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. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
 10. Electrical Operator: Provide remote control for on, off, and reset operations.

11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.6 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 9.

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 Division 26 Section "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 Division 26 Section "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. Manufacturer's Field Service: Engage a factory-authorized service representative or 3rd party testing agency to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. 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.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION

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. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
 - 5. Retrofit kits for fluorescent lighting fixtures.
- B. Related Sections:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
 - 3. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

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:

ICTC Calexico Intermodal Transit Center

IFB Deliverable

INTERIOR LIGHTING
26 51 00 - 1
02/01/24

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 Division 23 Section "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 Division 23 Section "Diffusers, Registers, and Grilles."
 7. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
- 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. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
 4. Ceiling-mounted projectors.
 5. Structural members to which suspension systems for lighting fixtures will be attached.
 6. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 7. Perimeter moldings.
- B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- C. 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

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, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. L.E.D. Fixtures: Comply with UL for indoor and outdoor locations.
- F. Metal Parts: Free of burrs and sharp corners and edges.
- G. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- H. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- I. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.

- J. 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.
- K. 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.
- L. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23 Section "Diffusers, Registers, and Grilles."
 - 1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
 - 2. Heat-Removal Units: Air path leads through lamp cavity.
 - 3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
 - 4. Dampers: Operable from outside fixture for control of return-air volume.
 - 5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.3 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: 095 or higher.
 - 10. Power Factor: 0.98 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.
 - 12. Compatible to lighting controller or dimmer.
- B. luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for 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. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

- F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
 - 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

- G. 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.

- H. Ballasts for Tri-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 and 60 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 tri-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: 0.98 or higher.
 - 10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

2.5 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. 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 for single-lamp ballasts.
 3. Rated Ambient Operating Temperature: 104 deg F.
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
 2. Rated Ambient Operating Temperature: 130 deg F.
 3. Lamp end-of-life detection and shutdown circuit.
 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. 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 non-consumer equipment.
 10. Protection: Class P thermal cutout.
 11. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
 12. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.
 - a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
- C. 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.

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.

2.7 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- C. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours unless otherwise indicated.
- D. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.
- E. 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, and suitable for use with dimming ballasts unless otherwise indicated.
 - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
 - 7. 70 W: T4, triple tube, rated 5200 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. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.
- E. Low-Pressure Sodium Lamps: ANSI 78.41, CRI 0, and color temperature 1800 K.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures:
 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. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Lighting Fixture Support:
 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging, or as required by Code.
 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.
- F. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

- A. Install labels, or mark cover with permanent, pen with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "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. 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.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 3 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect and Lighting Designer.

END OF SECTION

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. Division 26 Section "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, distributed as stated in AASHTO LTS-4-M.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4-M Ice Load Map.
- D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1. Basic wind speed for calculating wind load for poles exceeding 49.2 feet in height is 100 mph .
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 50 years.
 - c. Velocity Conversion Factors: 1.0.
2. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factors: 1.0.

1.5 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. Ballasts, including energy-efficiency data.
 6. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
 7. Materials, dimensions, and finishes of poles.
 8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 9. Anchor bolts for poles.
 10. 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. Wiring Diagrams: For power, signal, and control wiring.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaries, poles and luminaire lowering devices to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. 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.
- 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. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.8 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 above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
 - 1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
 - 2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
 - 3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Medium bronze.
- 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 and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
 - 2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.
- B. Ballast Characteristics:
 - 1. Power Factor: 90 percent, minimum.
 - 2. Sound Rating: Class A.
 - 3. Total Harmonic Distortion Rating: Less than 10 percent.
 - 4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 - 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 - 6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
- C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F and higher.

2.4 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.
 - 3. Normal Ambient Operating Temperature: 104 deg F.
 - 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
- B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.
- C. 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.

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, 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 Division 03 Section "Cast-in-Place Concrete."
- F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.7 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
 - 1. Shape: Round, tapered.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Steel Mast Arms: Davit 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. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- H. 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.
- I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by Architect from manufacturer's full range.

2.8 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: Round, tapered.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 - 2. Finish: Same as pole.
- F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Medium bronze.

2.9 POLE ACCESSORIES

- A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.
 - 1. Recessed, 12 inches above Pole base.
 - 2. Nonmetallic polycarbonate plastic or reinforced fiberglass, weatherproof in use, cover, that when mounted results in NEMA 250, Type 3R enclosure.
 - 3. With cord opening.
 - 4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

- D. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept ballast(s).
- E. Decorative accessories, supplied by decorative pole manufacturer, include the following:
 - 1. Banner Arms: .
 - 2. Flag Holders: .
 - 3. Ladder Rests: .

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 - 3. Trees: 15 feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers unless otherwise indicated.
 - 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Dig holes large enough to permit use of tampers in the full depth of hole.
 - 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

- F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 1. Make holes 6 inches in diameter larger than pole diameter.
 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
 3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 4. Cure concrete a minimum of 72 hours before performing work on pole.
- G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
- H. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.

3. Ground metallic components of pole accessories and foundations.

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.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS 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 and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Surface pathways.
 - 7. Boxes, enclosures, and cabinets.
 - 8. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 - 1. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
 - 2. Division 28 Section "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.
- D. RNC: Rigid Non-metallic conduit

1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, 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.
- D. Samples: For wireways nonmetallic wireways and surface pathways and for each color and texture specified, 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Alpha Wire Company.
 4. Anamet Electrical, Inc.
 5. Electri-Flex Company.
 6. O-Z/Gedney; a brand of EGS Electrical Group.
 7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
 8. Republic Conduit.
 9. Robroy Industries.
 10. Southwire Company.
 11. Thomas & Betts Corporation.
 12. Western Tube and Conduit Corporation.

13. Wheatland Tube Company; a division of John Maneely Company.
- B. General Requirements for Metal Conduits and Fittings:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
 - C. GRC: Comply with ANSI EPC—40PVC, C80.1 and UL 6.
 - D. ARC: Comply with ANSI C80.5 and UL 6A.
 - E. IMC: Comply with ANSI C80.6 and UL 1242.
 - F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit IMC.
 1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
 - G. EMT: Comply with ANSI C80.3 and UL 797.
 - 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 or die cast.
 - b. Type: compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
 - I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.
 4. Arco Corporation.
 5. CANTEX Inc.
 6. CertainTeed Corp.
 7. Condux International, Inc.
 8. Electri-Flex Company.
 9. Kraloy.
 10. Lamson & Sessions; Carlon Electrical Products.
 11. Niedax-Kleinhuis USA, Inc.
 12. RACO; a Hubbell company.
 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- 2. Comply with TIA-569-B.
- C. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. 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).
- I. 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 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Alpha Wire Company.
 - 2. Arcco Corporation.
 - 3. Endot Industries Inc.
 - 4. IPEX.
 - 5. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum and riser installation unless otherwise indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by 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.
 - 2. Comply with TIA-569-B.
- 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: Flanged-and-gasketed type unless otherwise indicated.

- E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. 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."

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. Hoffman; a Pentair company.
 - 6. Hubbell Incorporated; Killark Division.
 - 7. Lamson & Sessions; Carlon Electrical Products.
 - 8. Milbank Manufacturing Co.
 - 9. Molex; Woodhead Brand.
 - 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:
 - 1. Comply with TIA-569-B.
 - 2. 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. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 - F. 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.
 - G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
 - I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
 - J. Gangable boxes are prohibited.
 - K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
 - L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures:
 - a. Material: Fiberglass.
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
 - M. Cabinets:
 - 1. NEMA 250, Type 3R, 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.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- 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.
 3. Comply with TIA-569-B.
- 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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, "COMMUNICATIONS."
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of reinforced concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Nordic Fiberglass, Inc.
 - f. Oldcastle Precast, Inc.; Christy Concrete Products.
 - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
 - h. Jensen
 2. Standard: Comply with SCTE 77.
 3. Color of Frame and Cover: Gray.
 4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 7. Cover Legend: Molded lettering, "COMMUNICATIONS."
 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC or RNC, Type EPC-80-PVC.
 2. Concealed Conduit, Aboveground: GRC or RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC-80-PVC, concrete encased.
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway 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. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: IMC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, cast-metal fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Division 26 Section "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 two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- 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 of enclosures to which attached.
- I. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- O. 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.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 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 temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

- d. Attics: 135 deg F 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 of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 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.
- 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 surface 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. 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.
 - BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - CC. Set metal floor boxes level and flush with finished floor surface.
 - DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through 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 of concrete for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.
- 7. Underground Warning Tape: Comply with requirements in Division 26 Section "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 sieve to No. 4 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 above finished grade.
- D. Install handholes with bottom below frost line, 36" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 27 Section "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

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

END OF SECTION

SECTION 27 05 44

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

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 for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For sealants, 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."

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized-steel sheet.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Presealed Systems.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant 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."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 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.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Grounding.
- B. Related Requirements:
 - 1. Division 27 Section "Cable Trays for Communications Systems" for cable trays and accessories.
 - 2. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 3. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
 - 4. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. 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. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Seismic Qualification Certificates: For equipment frames 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. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD/NTS.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment frames 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."

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 EQUIPMENT FRAMES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Belden Inc.
 2. Cooper B-Line.
 3. Hubbell Premise Wiring.
 4. Leviton Commercial Networks Division.
 5. Ortronics, Inc.
 6. Panduit Corp.
 7. Siemon Co. (The).
 8. Chatsworth
- B. General Frame Requirements:
1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, aluminum construction.
1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat finish.
- D. Modular Freestanding Cabinets:
1. Removable and lockable side panels.
 2. Hinged and lockable front and rear doors.
 3. Adjustable feet for leveling.
 4. Screened ventilation openings in the roof and rear door.
 5. Cable access provisions in the roof and base.
 6. Grounding bus bar.
 7. Rack-mounted, 550-cfm fan with filter.
 8. Power strip.
 9. Baked-polyester powder coat finish.
 10. All cabinets keyed alike.
- E. Modular Wall Cabinets:
1. Wall mounting.
 2. Steel construction.
 3. Treated to resist corrosion.
 4. Lockable front and rear doors.
 5. Louvered side panels.
 6. Cable access provisions top and bottom.
 7. Grounding lug.
 8. Rack-mounted, 250-cfm fan.
 9. Power strip.
 10. All cabinets keyed alike.
- F. Cable Management for Equipment Frames:
1. Metal, with integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Vertical cable management panels shall have front and rear channels, with covers.
 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Rack mounting.
 - 3. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 4. LED indicator lights for power and protection status.
 - 5. LED indicator lights for reverse polarity and open outlet ground.
 - 6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - 7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 - 8. Cord connected with 15-foot line cord.
 - 9. Rocker-type on-off switch, illuminated when in on position.
 - 10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 - 11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with J-STD-607-A.

2.6 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Comply with requirements in Division 27 Section "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 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 Division 27 Section "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION

SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

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. Pathways.
 - 2. UTP cable.
 - 3. 62.5/125-micrometer, optical fiber cabling.
 - 4. Coaxial cable.
 - 5. Cable connecting hardware, patch panels, and cross-connects.
 - 6. Cabling identification products.
- B. Related Sections:
 - 1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 CLOSEOUT SUBMITTALS

- A. 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. Patch-Panel Units: One of each type.
 2. Connecting Blocks: One of each type.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications:
 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP cable for open and short circuits.
 4. Provide Test Reports at the end of the project.

1.12 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry.

1.13 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE (CMP)

- A. Manufacturers: Subject to compliance with requirements, provide Category 6 and Category 6A cables products by one of the following:
 - 1. Belden CDT Inc.; Electronics Division.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Draka USA.
 - 5. Genesis Cable Products; Honeywell International, Inc.
 - 6. KRONE Incorporated.
 - 7. Mohawk; a division of Belden CDT.
 - 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 9. Superior Essex Inc.
 - 10. SYSTIMAX Solutions; a CommScope Inc. brand.
 - 11. 3M.
 - 12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

- B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 3.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
 - e. Multipurpose: Type MP or MPG; or MPP or MPR.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Technology Systems Industries, Inc.
 2. Dynacom Corporation.
 3. Hubbell Premise Wiring.
 4. KRONE Incorporated.
 5. Leviton Voice & Data Division.
 6. Molex Premise Networks; a division of Molex, Inc.
 7. Nordex/CDT; a subsidiary of Cable Design Technologies.
 8. Panduit Corp.
 9. Siemon Co. (The).
 10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. Data is to be Blue and Voice is Gray.

- G. Patch Cords: Factory-made, 4-pair cables in 36-inch lengths; terminated with 8-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
 - 3. Data to be Blue and Voice is Gray.

2.5 OPTICAL FIBER CABLE (CMP)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek; a Nexans company.
 - 2. CommScope, Inc.
 - 3. Corning Cable Systems.
 - 4. General Cable Technologies Corporation.
 - 5. Mohawk; a division of Belden CDT.
 - 6. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 7. Optical Connectivity Solutions Division; Emerson Network Power.
 - 8. Superior Essex Inc.
 - 9. SYSTIMAX Solutions; a CommScope Inc. brand.
 - 10. 3M.
 - 11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

- B. Description: Multimode, 62.5/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Comply with TIA/EIA-492AAAA-A for detailed specifications.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
 - 5. Conductive cable shall be steel armored type.
 - 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

- C. Jacket:
 - 1. Jacket Color: Black for 62.5/125-micrometer cable and shall be suitable for underground installation.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 OPTICAL FIBER CABLE HARDWARE

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

ICTC Calexico Intermodal Transit Center

COMMUNICATIONS BACKBONE CABLING

IFB Deliverable

27 13 00 - 6
02/01/24

1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Berk-Tek; a Nexans company.
 4. Corning Cable Systems.
 5. Dynacom Corporation.
 6. Hubbell Premise Wiring.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 9. Optical Connectivity Solutions Division; Emerson Network Power.
 10. Siemon Co. (The).
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- D. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE (CMP)

- A. Manufacturers: Subject to compliance with requirements, provide products RG-11, RG-59 by one of the following:
1. Alpha Wire Company.
 2. Belden CDT Inc.; Electronics Division.
 3. Coleman Cable, Inc..
 4. CommScope, Inc.
 5. Draka USA.
- B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-11/U: NFPA 70, Type CMP, CATV.
1. No. 14 AWG, solid, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 4. Jacketed with sunlight-resistant, black PVC or PE.
 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- D. RG59/U: NFPA 70, Type CATVR.
1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.

4. Color-coded PVC jacket.
- E. RG-6/U: NFPA 70, Type CATV or CM.
1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 3. Jacketed with black PVC or PE.
 4. Suitable for indoor installations.
- F. RG59/U: NFPA 70, Type CMP, CATV.
1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 3. PVC jacket.
- G. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 3. Copolymer jacket.
- H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV, or CATVP or CATVR.
 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 3. CATV Riser Rated: Type CATVR; or CATVP, CATVR, or CATV, complying with UL 1666.
 4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aim Electronics, a brand of Emerson Electric Co.
 2. Leviton Voice & Data Division.
 3. Siemon Co. (The).
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Tri-Signal Integration.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 10. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
 - 1. Comply with TIA/EIA-568-B.3.
 - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 1.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections in presence of AHJ.
- B. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

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. UTP cabling.
 2. 62.5/125-micrometer, optical fiber cabling.
 3. Coaxial cable.
 4. Multiuser telecommunications outlet assemblies.
 5. Cable connecting hardware, patch panels, and cross-connects.
 6. Telecommunications outlet/connectors.
 7. Cabling system identification products.
 8. Cable management system.
- B. Related Requirements:
 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For Category 6, Category 6A, coaxial cable RG-11, RG-59 cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- 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.

1.8 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. Patch-Panel Units: One of each type.
 2. Connecting Blocks: One of each type.
 3. Device Plates: One of each type.
 4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.
 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- 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. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.4 UTP CABLE (CMP)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. ADC.
 2. Belden Inc.
 3. Berk-Tek; a Nexans company.
 4. CommScope, Inc.
 5. Draka Cableteq USA.
 6. Genesis Cable Products; Honeywell International, Inc.
 7. Mohawk; a division of Belden Networking, Inc.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 10. 3M Communication Markets Division.
 11. Tyco Electronics Corporation; AMP Products.
- B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.
 - b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
 - e. Multipurpose: Type MP or MPG; or MPP or MPR.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

2.5 UTP CABLE HARDWARE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Belden Inc.
 4. Dynacom Inc.
 5. Hubbell Premise Wiring.
 6. Leviton Commercial Networks Division.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Panduit Corp.
 9. Siemon Co. (The).
 10. Tyco Electronics Corporation; AMP Products.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.6 OPTICAL FIBER CABLE (CMP)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Belden Inc.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. Corning Cable Systems.
 5. CSI Technologies Inc.
 6. General Cable Technologies Corporation.
 7. Mohawk; a division of Belden Networking, Inc.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 10. 3M Communication Markets Division.
 11. Tyco Electronics Corporation; AMP Products.
- B. Description: Multimode, 62.5/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 3. Comply with TIA-492AAAB for detailed specifications.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
 5. Conductive cable shall be steel armored type.
 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
1. Jacket Color: Orange for 62.5/125-micrometer cable.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.7 OPTICAL FIBER CABLE HARDWARE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Belden Inc.
 4. Berk-Tek; a Nexans company.
 5. Corning Cable Systems.
 6. CSI Technologies Inc.
 7. Dynacom Inc.

8. Hubbell Premise Wiring.
 9. Molex Premise Networks; a division of Molex, Inc.
 10. Siemon Co. (The).
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- D. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.8 COAXIAL CABLE (CMP)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Alpha Wire Company.
 2. Belden Inc.
 3. Coleman Cable, Inc.
 4. CommScope, Inc.
 5. Draka Cableteq USA.
- B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-11/U: NFPA 70, Type CATV.
1. No. 14 AWG, solid, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 4. Jacketed with sunlight-resistant, black PVC or PE.
 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- D. RG59/U: NFPA 70, Type CATVR.
1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
 4. Color-coded PVC jacket.
- E. RG-6/U: NFPA 70, Type CCTV or CM.
1. No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 3. Jacketed with black PVC or PE.
 4. Suitable for indoor installations.

- F. RG59/U: NFPA 70, Type CATV.
 - 1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 - 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 - 3. PVC jacket.
- G. RG59/U (Plenum Rated): NFPA 70, Type CMP.
 - 1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 - 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 - 3. Copolymer jacket.
- H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
 - 1. CATV Cable: Type CATV, or CATVP or CATVR.
 - 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 - 3. CCTV Riser Rated: Type CATVR; or CATVP, CATVR, or CATV, complying with UL 1666.
 - 4. CATV Limited Rating: Type CATVX.

2.9 COAXIAL CABLE HARDWARE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Emerson Network Power Connectivity Solutions.
 - 2. Leviton Commercial Networks Division.
 - 3. Siemon Co. (The).
 - 4. Liberty.
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.10 CONSOLIDATION POINTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. American Technology Systems Industries, Inc.
 - 2. Belden Inc.
 - 3. Chatsworth Products, Inc.
 - 4. Dynacom Inc.
 - 5. Hubbell Premise Wiring.
 - 6. Molex Premise Networks; a division of Molex, Inc.
 - 7. Ortronics, Inc.; a subsidiary of Legrand Group.
 - 8. Panduit Corp.
 - 9. Siemon Co. (The).
 - 10. Tyco/Amp.
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
 - 2. Number of Connectors per Field:
 - a. One for each four-pair UTP cable indicated.

- b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
- 3. Mounting: Recessed in ceiling.
- 4. NRTL listed as complying with UL 50 and UL 1863.
- 5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.11 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Belden Inc.
 - 2. Chatsworth Products, Inc.
 - 3. Hubbell Premise Wiring.
 - 4. Molex Premise Networks; a division of Molex, Inc.
 - 5. Ortronics, Inc.; a subsidiary of Legrand Group.
 - 6. Panduit Corp.
 - 7. Siemon Co. (The).
- B. Description: MUTOAs shall meet the requirements for cable connecting hardware.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
 - 2. Number of Connectors per Field:
 - a. One for each four-pair UTP cable indicated.
 - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
 - 3. Mounting: Recessed in ceiling.
 - 4. NRTL listed as complying with UL 50 and UL 1863.
 - 5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.
 - 6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.12 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two-port-connector assemblies mounted in single or multigang faceplate.
 - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
 - 2. Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices."
 - 3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 - 4. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.
 - 5. Legend: Machine printed, in the field, using adhesive-tape label.
 - 6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.13 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

- B. Comply with J-STD-607-A.

2.14 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.15 CABLE MANAGEMENT SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. iTRACS Corporation, Inc.
 - 2. TelSoft Solutions.
- B. Description: Computer-based cable management system, with integrated database and graphic capabilities.
- C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- D. Information shall be presented in database view, schematic plans, or technical drawings.
 - 1. AutoCAD drawing software shall be used as drawing and schematic plans software.
- E. System shall interface with the following testing and recording devices:
 - 1. Direct upload tests from circuit testing instrument into the personal computer.
 - 2. Direct download circuit labeling into labeling printer.

2.16 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements in Division 27 Section "Pathways for Communications Systems."
 - 3. Comply with requirements in Division 27 Section "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

- a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 1.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
 6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
 7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
 8. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."
 9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.8 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 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.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all clearing and grubbing together with the removal and disposal of items, as shown on the drawings and as specified, complete.

1.02 JOB CONDITIONS

- B. Condition of Premises: Accept the premises as found and clear the Project site as specified.
- C. Protection:
 - 1. Existing Vegetation. Protect from damage individual trees, groups of trees, shrubbery, lawns and other vegetation designated to remain. Replace at Contractor's expense items damaged or destroyed with like items in sizes and quantity of the damaged or destroyed material. Assessment of material value shall be established by Owner.
 - 2. Protect existing utilities and utility poles designated to remain per plan.
 - 3. Provide barricades and guards as required to protect trees or existing improvements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.01 PERFORMANCE

- A. Clearing and Grubbing:
 - 1. Clearing: Dispose of trees and other vegetation designated for removal, together with brush and rubbish, occurring within the construction limits. Trim individual trees and groups of trees designated to remain within the cleared areas of all dead branches and of all live branches to such heights and in such manner as are indicated on the Drawings or approved by Owner. All limbs, branches and roots damaged during construction, together with those required to be trimmed, shall be neatly cut next to the bole of the tree or main branch or root. Cuts more than 1 inch in diameter thus made and any injury to the tree trunk or main branches shall be immediately painted with tree wound paint.
 - 2. Grubbing: Remove and dispose of all stumps, all matted roots, and all roots larger than 3 inches in diameter in all construction areas, in all cut areas and in all other areas having less than 2 feet of fill.
 - 3. Removal: All cleared and grubbed materials shall be promptly removed completely away from the Project site. Do not store or permit debris to accumulate on the Project site.
 - a. Do not burn materials or debris on the premises.
 - b. Remove all debris from the Project site to a legal dumping area.

END OF SECTION

SECTION 31 11 50
DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all wrecking and demolition, including the removal and legal disposal of items, as shown on the drawings and as specified, complete.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Traffic.
 - a. Obstruction. Do not close, obstruct, or store material or equipment in street, sidewalks, or alleys in accordance with the requirements provided by the City of Calexico.

1.03 JOB CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Cooperate with Owner and utility companies in maintaining respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
- C. Demolish and completely remove from site existing underground utilities to be removed. Coordinate with utility companies to shut off services if lines are active.
- D. Environmental Requirements:
 - 1. Wrecking and Demolition. Accomplish wrecking and demolition in a manner that provides for the safety of the public and all workers and provides for the protection of all property not to be wrecked or demolished. Methods shall be subject to approval of Owner.
 - 2. Surface Water. After the existing buildings or structures have been removed, protect the resulting building excavation or open area and utility trenching from surface water. Promptly remove any water which accumulates in the excavation or opening. The method of dewatering and the disposal of the water is subject to approval by Owner.
 - a. Prevent surface water from running into the excavated areas. Water which accumulates in the excavation shall be removed promptly. Provide and maintain all necessary bailing, draining, pumping, and sheathing.
 - b. Contractor shall be responsible for all additional Work required if ingress of ground or surface water softens excavated areas to the satisfaction of Geotechnical Engineer or Field Inspector.

1.04 SUBMITTALS

- A. Submit to the Engineer and Owner for approval.
 - 1. Demolition and abandonment as-built redline markup
 - 2. Dust control means and methods
 - 3. Traffic Control Plan

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.01 INSPECTION

ICTC Calexico Intermodal Transit Center

IFB Deliverable

DEMOLITION

31 11 50 - 1

02/01/24

- A. Condition of Premises: Accept the premises as found and clear the Project site as specified.

3.02 PREPARATION

- A. Utilities:
 - 1. Contractor shall identify, confirm, and survey existing utilities within project limits prior to demolition. Any deviations from the existing conditions shown on plan shall be brought to the attention of the Engineer prior to demolition work.
 - 2. Prior to disconnecting, removing, plugging, or abandoning existing utilities serving the buildings being removed, obtain approval from the utility purveyor and provide sufficient notice to any impacted users. Disconnections, removals, and shut-offs shall not impact other business or residences without consent and approval by utility purveyor and Owner.
- B. Protection:
 - 1. Contractor shall protect all structures, utilities, trees, and other items indicated to remain on the Drawings during Demolition and for the duration of the Project.

3.03 PERFORMANCE

- A. Performance:
 - 1. Wrecking and Demolition. Dismantle and remove all items and obstructions as shown on the Drawings for removal or called out in these Specifications. Remove all foundations completely. Remove all pavement, curbs and sidewalks and other concrete slabs as required to execute the work. Do not damage adjacent remaining pavement or sidewalks. Make pavement sawcuts in such a manner that a clean, vertical joint remains.
 - 2. The ends of abandoned utilities shall be capped or plugged as approved, at locations shown or specified on the Drawings. Contractor shall provide as-built redline markups with survey locations and identification information of all abandoned utilities as Submittal to Owner.
- B. Removal:
 - 1. Unless otherwise specified, all materials removed shall become the property of Contractor and shall be removed completely away from the Project site for disposal at a legal dumping site. Contractor shall secure and pay for required hauling permits and pay dumping fees and charges.
 - 2. Salvaged items identified by the Owner shall be returned to the Owner.

3.04 FIELD QUALITY CONTROL

- A. Workmanship:
 - 1. Demolition Work. Execute in an orderly manner with due consideration for adjacencies and the public. Execute the Work to insure adjacent properties and the public against damages incurred by falling debris or other causes.
 - 2. Burning of Materials. Burn no materials or debris on the premises.
 - 3. Dust Control. Contractor shall maintain dust control through duration of demolition work and project. Contractor shall provide means and methods acceptable to Owner.
- B. Traffic:
 - 1. Interference. Conduct operations with minimum interference with roads, streets, driveways, alleys, sidewalks, and other facilities. Flagmen shall be used as necessary for traffic control. Maintain safe access to public at all times. Contractor shall provide Traffic Control Plan as submittal for Engineer and Owner review.

3.05 ADJUSTMENT AND CLEANING

- A. Repairs and Replacements: Clean up, repair, or replace at no cost to Owner all property damaged by reason of required Work, including restoring all disturbed areas, surfaced and unsurfaced, to their original condition on completion of the Work as approved. All patchwork shall match existing. Painted surfaces shall be painted to match the adjacent areas.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes (but is not necessarily limited to):
 - 1. Rough grading earthwork.
 - 2. Excavating, trenching, and backfill.
 - 3. Finished grading and surfacing.

1.02 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe or conduit in a trench, including haunches to support sides of pipe or conduit.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Layer placed between the subbase course and asphalt paving
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- F. Engineered Fill: Fill material placed at the direction of the soils engineer.
- G. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Owner. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Owner. Unauthorized excavation, as well as remedial work not directed by Owner, shall be without additional compensation.
- H. Fill: Soil materials used to raise existing grades.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities include on-site underground or overhead pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 23 16 – Trenching.
- B. Section 33 05 00 - Installation of Buried Pipe.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Drainage fabric.
 - 2. Separation fabric.
- B. Samples: For the following:
 - 1. 10-lb. samples, sealed in airtight containers, of each proposed soil material from on-site or off-site borrow sources. This does not include Owner's stockpile.
 - 2. 12-by-12-inch sample of drainage fabric.
 - 3. 12-by-12-inch sample of separation fabric.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with the following requirements:
 - 1. Classification according to ASTM D 2487 of each on-site or off-site borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 1557 for each on-site or off-site borrow soil material proposed for fill and backfill.
 - 3. Laboratory compaction curve according to ASTM D 1557 for each on-site or off-site borrow soil material proposed for fill and backfill.
- D. Blasting will not be permitted.

1.05 REFERENCES

- A. Standard Specifications for Public Works Construction ("Greenbook"), 2021 edition.

1.06 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency, hired by Owner, qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Cooperate with Owner and utility companies in maintaining respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
- C. Demolish and completely remove from site existing underground utilities to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available onsite.
- B. Satisfactory Soils: Refer to Standard Specifications for Public Works Construction (SSPWC) "Greenbook" for recommendations.

- C. Unsuitable Soils: Refer to Standard Specifications for Public Works Construction (SSPWC) “Greenbook” for recommendations. Unsuitable soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 90 percent passing a 1-1/2- inch sieve and not more than 12 percent passing a No. 200 sieve. Must meet Greenbook standards.
- F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve for Class II Base.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve. Must meet Greenbook standards.
- H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 DRAINAGE FABRIC

- A. Non-woven geotextile, specifically manufactured as a drainage geotextile: Mirafi 140N or equivalent

2.03 SEPARATION FABRIC

- A. Impermeable liner: 30 ML HDPE or PVC material.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.03 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

- A. Excavations to be performed in accordance with Standard Specifications for Public Works Construction, "Greenbook," Section 300.
- B. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- C. Classified Excavation: Excavation to subgrade elevations classified as earth and rock. Rock excavation will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 2. Rock excavation includes removal and disposal of rock.
 - a. Do not excavate rock until it has been classified and cross-sectioned by Owner.

3.05 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavation for Mechanical or Electrical Utility Structures: Excavate to required elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to required cross sections, elevations, and grades.
- B. Excavations shall be in accordance with the Standard Specifications for Public Works Construction (SSPWC) "Greenbook," Section 300-2.

3.07 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to required gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of minimum of 24" below finished grade.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise required to meet minimum cover.

1. Clearance: unless otherwise shown on the drawings, 12 inches on each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Depth: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.08 APPROVAL OF SUBGRADE

- A. Notify Owner when excavations have reached required subgrade.
- B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed by Owner.
 1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Owner.

3.09 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Owner.
- B. Fill unauthorized excavations under other construction or utility pipe as directed by Owner.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations a minimum distance equal to the depth of excavation.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade.
- H. Install detectable warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Place and compact fill material in layers to required elevations as follows:
 1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill material on surfaces that are muddy or contain frost or ice.
 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Unless otherwise specified on the drawings or in the soils report, compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 90 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - 3. Stripping. When fills are to be constructed over cultivated or fallowed land, the entire area upon which the fill is to be constructed shall first be cleared of vegetation and then smoothed with a blade grader. When fills are to be constructed over sodded surfaces, the sod shall be stripped to a depth of 2 inches. These smoothed or stripped surfaces shall then be rolled to the specified density required for fill prior to the fill material placement. Dispose of stripped material as waste and completely remove from the Project site.
 - 4. Conservation of Topsoil. Deposit topsoil in storage piles convenient to the areas which are subsequently to receive application of topsoil. Stockpile topsoil free of roots, stones and other undesirable material as specified in Section 3.10 above. Keep topsoil, when stored, separate from other excavated materials. Cover storage piles as required to prevent windblown dust.
 - 5. Fills. Construct fills at the locations and to the lines and grades indicated on the Drawings. Ensure that the completed fill corresponds to the shape of the typical sections shown on the Drawings or meets the requirements of that particular case. Use all approved material removed from the excavation in forming the necessary fill. All fill material shall be free from logs, stumps, sod, weeds, trash or other perishable material, and from all stones having a maximum dimension greater than 6 inches. No stones shall be permitted in the top 12 inches of fills. Place the material in successive horizontal layers not exceeding 8 inches in loose depth. Use a blade grader to keep fill material spread uniformly. Remove any soft sections, holes or depressions to required grades and refill with material as approved, and shape the entire area to line, grade, and cross section and thoroughly compact as specified. Contractor is responsible for adjustment of the moisture content of the fill material so that the specified compaction can be obtained. The rough grade for the entire Project site or portion thereof shall be approved by Owner before placement of any topsoil.
 - a. Subgrade Preparation. Subgrades for all drives, parking areas, sidewalks and other structures shall be shaped, dressed, moistened, and compacted as specified. Test the subgrade for crown, elevation, and density in advance of placing pavement.

- b. Spreading of Topsoil. Upon completion of rough grading, spread the stockpiled topsoil for a uniform depth of 6 inches, after settlement, over all areas graded not receiving other surfacing, just prior to the sodding or landscaping operation. Before spreading the topsoil, scarify the graded areas for a depth of 3 inches and repair all settlements and washes.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Finished Grading. Accomplish uniformly smooth grading of all areas covered within the limits of the work, including excavated and filled sections and adjacent transition areas so that the finished surface is smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations except as otherwise specified. Finish all drainage courses so as to drain readily.
 - 1. Backfill material shall be the same as specified for fill and shall be placed and compacted as specified for fill unless otherwise noted.
- D. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in a minimum of 12 inches of filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.
 - 1. Compact each course of filter material to 90 percent of maximum dry unit weight according to ASTM D 1557.
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 6 inches.
 - 1. Compact each course of filter material to 90 percent of maximum dry density according to ASTM D 1557.
 - 2. Place and compact impervious fill material over drainage backfill to final subgrade.
- C. Perforated Subsurface Drain within Storm Drain Basin. Install perforated subdrain piping, associated fill, filter fabric, and liners per basin detail on Drawings.

3.18 BASE COURSES

- A. Under pavements and walks, place base course on prepared subgrade and as follows:
 - 1. Place base course material over subgrade.
 - 2. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 90 percent of maximum dry unit weight according to ASTM D 1557.
 - 3. Shape base to required crown elevations and cross-slope grades.
 - 4. When thickness of compacted base course is 6 inches or less, place materials in a single layer.

5. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 8 inches thick loose material or less than 4 inches thick when compacted.

3.19 DRAINAGE COURSE

- A. Under slabs-on-grade, install drainage fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
- B. Under slabs-on-grade, place drainage course on prepared subgrade and as follows, unless otherwise specified by the Geotechnical Engineer:
 1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
 2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
 3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will furnish a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design-bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556 and ASTM D 2922 as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify, and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property at Contractor's expense.

END OF SECTION

**SECTION 31 23 16
TRENCHING**

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Backfilling and compacting for utilities outside the building to utility main connections.

1.2 RELATED DOCUMENTS

- A. Section 31 20 00 – EARTHWORK

1.3 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.
- C. Trench Zone: The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.
- D. Pipe Base: The pipe base shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be four inches (4") below the lowest point of the pipe or bell.
- E. Pipe Zone: The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as specified below. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be 12 inches.

1.4 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop. 2020 Edition.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m^{3- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m^{3- D. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). 2020 Edition.}}

1.5 SUBMITTALS

- A. Compaction Density Test Reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. General Fill:
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D2487 Group Symbol CL.
- B. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
 - 1. Grade in accordance with ASTM D2487 Group Symbol SW.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed.

3.3 TRENCHING

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove excavated material that is unsuitable for re-use from site.
- H. Remove excess excavated material from site.
- I. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Engineer. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- J. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Owner.

3.4 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.5 BACKFILLING

- A. Backfill to contours and elevations indicated.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
- H. Reshape and re-compact fills subjected to vehicular traffic.

3.6 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Utility piping:
 - 1. Pipe Base and Pipe Zone: Use sand.
 - 2. Compact in maximum 8-inch lifts to 95 percent of maximum dry density.

3.7 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.8 FIELD QUALITY CONTROL

- A. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180 or ASTM D698 ("standard Proctor").
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.9 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

**SECTION 32 11 23
AGGREGATE BASE COURSES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 31 20 00– Earthwork
- B. Section 32 12 16 – Asphalt Paving
- C. Section 32 13 13.01 – Sitework Concrete

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses 2017.
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2018.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2014.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012, with Editorial Revision (2015).
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method 2007.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)) 2012, with Editorial Revision (2015).
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017.
- I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils 2017, with Editorial Revision (2018).
- J. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) 2017a.

1.04 SUBMITTALS

- A. Submit to the engineer for approval.
- B. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- C. Compaction Density Test Reports.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Coarse Aggregate Type Caltrans Class 2: Natural washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with Caltrans Standard Specifications Section 26.

- B. Fine Aggregate Type: Sand; complying with Standard Specifications for Public Works Construction, "Greenbook".

2.02 SOURCE QUALITY CONTROL

- A. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated on the Drawings.

3.02 PREPARATION

- A. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Install aggregate per details referenced on plans.
- B. Spread aggregate over prepared substrate to a total compacted thickness as indicated on plans.
- C. Place aggregate in maximum 4-inch layers and roller compact to specified density.
- D. Level and contour surfaces to elevations and gradients indicated.
- E. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- F. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 FIELD QUALITY CONTROL

- A. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167 or ASTM D6938.
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- C. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

3.05 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

**SECTION 32 12 16
ASPHALT PAVING**

PART 1 – GENERAL

1.01 SUMMARY

- A. Work included:
1. Constructing one or more surface courses composed of a mixture of aggregate, filler if required, and asphalt concrete material, placed on a prepared base.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. C 117 – Test Method for Material Finer than 75 mM (Number 200) Sieve in Mineral Aggregates by Washing.
 2. C 131 – Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 3. C 136 – Method for Sieve Analysis of Fine and Coarse Aggregates.
 4. D 977 – Standard Specification for Emulsified Asphalt.
 5. D 1559 – Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
 6. D 3381 – Specification for Viscosity Graded Asphalt Cement for Use in Pavement Construction.
 7. D 4318 – Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 8. State of California, Department of Transportation (Caltrans), Standard Specifications, most current edition.
- B. Standard Specifications for Public Works Construction, most current edition.

1.03 SUBMITTALS

- A. Job Mix Formula: Before producing asphalt concrete mixture, submit a job mix formula for each mixture to the Owner for approval. Should a change in source of material be proposed, or should a job mix formula prove unsatisfactory, submit a new job mix formula for approval.
1. Each job mix formula submitted shall propose definite single values for:
 - a. The percentage of aggregate passing each specified sieve, based on dry weight of aggregate. These percentages shall be within the range shown in Part 2 of this section.
 - b. The percentage of asphalt concrete material to be added, based on the total weight of the mixture, and the percentage of any stabilizing agent such as lime, portland cement, or antistrip agent.
 2. In addition, the job mix formula shall provide a mixture having a minimum wet retained strength of 125 psi, as determined by AASHTO T165 82, and an index of retained strength of not less than 70 percent.
- B. Samples: Asphalt cement, 1-quart minimum sample for each load delivered.
- C. Certificates:
1. Certification from supplier that asphalt cement is of correct type and meets requirements of this section. Two copies will be required for each load.
 2. Two copies of certified weight ticket from supplier for each load of asphalt cement.
 3. Two copies of certified weight tickets for each load of asphalt concrete.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Asphalt Concrete Delivery.
1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of all foreign materials.
 2. Treat bodies as necessary to prevent material from sticking to the bodies.
 3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.

1.05 PROJECT CONDITIONS

- A. Apply mixture only during daylight hours; when air temperature is 50 degrees Fahrenheit (F) or higher; when surfaces to be paved are dry and free of frost, snow, or ice; and when precipitation is not imminent.

PART 2 – PRODUCTS

2.01 AGGREGATE

- A. The aggregate shall meet the general and physical requirements of ASTM C131.
- B. Coarse aggregate is defined as that portion of a representative sample retained on a No. 8 sieve, whereas fine aggregate is defined as that portion passing the No. 8 sieve.
- C. The aggregates for the mixture shall be graded and combined in such proportions that the resulting composite blend meets the requirements of the job mix formula. The job mix formula with the allowable tolerances shall be within the master range set forth in the Greenbook, table 201-1.3.2.

2.02 ASPHALT CONCRETE MATERIAL

- A. Prime/tack coat shall be Type SC 70 liquid asphalt conforming to the requirements of the Greenbook Section 302-5.3 and 302-5.4.
- B. Asphalt concrete surfacing shall conform to the requirements of the Greenbook Section 302. Mineral aggregate shall be ½ inch maximum size, Type II.

2.03 FILLER

- A. If filler is required, the filler material shall meet the requirements of AASHTO M 17 77.

PART 3 – EXECUTION

3.01 EQUIPMENT

- A. Plant, hauling, placing, and rolling equipment shall be adequate to ensure uniformity and continuity of operations and be in good operating condition capable of performing according to manufacturer's specifications. The Contractor may, at his option, use the type plant he desires, provided the equipment meets the following requirements.
- B. Requirements for All Plants:
 - 1. Equipment for Preparation of Asphalt Concrete Material: Tanks for the storage of asphalt concrete material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that flame will not be in contact with the tank. The circulating system for the asphalt concrete material shall be designed to ensure proper and continuous circulation during the operating period. Provision shall be made for measuring and sampling material in storage tanks.
 - 2. Feeder for Dryer: The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the dryer to obtain uniform production and temperature.
 - 3. Dryer: The plant shall include a dryer or dryers that continuously agitate the aggregate during the heating and drying process.
 - 4. Screens: Aggregate gradation control shall be provided either with plant screens or screenless plants in accordance with the following methods:
 - a. METHOD A: Plant screens shall screen the hot aggregate to the specified sizes and proportions and have normal capacities in excess of the full capacity of the mixer.
 - b. METHOD B: Screenless plants with cold feed control shall have the cold aggregate separated and stored in separate coarse aggregate and fine aggregate stockpiles.
 - 5. Hot Aggregate Bins: Pugmill plants shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the hot mineral aggregates. Separate dry storage shall be provided for filler or hydrated lime when used, and the plant shall be

equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate, constructed so that when closed there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points.

6. Asphalt Concrete Control Unit: Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of asphalt concrete material in the mix. Means shall be provided for checking the quantity or rate of flow of asphalt concrete material into the mixer.
7. Thermometric Equipment: An armored thermometer of adequate range shall be fixed in the asphalt concrete feed line at a suitable location near the charging valve at the mixer unit. The plant shall also be equipped with an approved temperature measuring apparatus placed at the discharge chute of the dryer.
8. Emission Control: Dust, smoke, or other contaminants shall be controlled by appropriate devices at the plant site to meet air pollution requirements.
9. Commercial Binders or Fillers: When materials are to be used that require the mixing of commercial binders or fillers with the aggregate, a central mixing plant of the twin-pugmill type will be required. Other methods that ensure a thorough and homogeneous mixture will be permitted on written approval.

C. Requirements for Batching Plants:

1. Weight Box or Hopper: The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that material is not allowed to leak into the mixer while a batch is being weighed.
2. Asphalt Concrete Control: The equipment used to measure the asphalt concrete material shall be accurate to plus or minus 0.5 percent. The asphalt concrete material bucket shall be non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than $\frac{3}{4}$ the length of the mixer and it shall discharge directly into the mixer. The asphalt concrete material bucket, its discharge valve or valves, and spray bar shall be adequately hosted. Steam jackets, if used, shall be efficiently drained and all connections shall be so constructed that they will not interfere with the efficient operation of the asphalt concrete scales. The capacity of the asphalt concrete material bucket shall be at least 15 percent in excess of the weight of asphalt concrete material required in any batch. The plant shall have an adequately heeled, quick acting, nondrip, charging valve located directly over the asphalt concrete material bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of asphalt concrete material used in a batch. The dial shall be in full view of the mixer operator.

The flow of asphalt concrete material shall be controlled so that it will begin when the dry mixing period is over. All of the asphalt concrete material required for one batch shall be discharged not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt concrete material the full length of the mixer. The section of the asphalt concrete line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for an asphalt concrete material bucket.

3. Mixer: The batch mixer shall be an approved type capable of producing a uniform mixture within the job mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

The clearance of blades from all fixed and moving parts shall not exceed 1 inch unless the maximum diameter of the aggregate in the mix exceeds $1\frac{1}{4}$ inches, in which case the clearance shall not exceed $1\frac{1}{2}$ inches.

- D. Hauling Equipment: Trucks used for hauling asphalt concrete mixtures shall have tight, clean, smooth metal beds that have been thinly coated with a minimum amount of paraffin oil, lime

solution, or other approved material to prevent the mixture from adhering to the beds. Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather.

- E. Rollers: Rollers shall be of the steel wheel, vibratory, pneumatic tire type, or combination, capable of reversing without backlash. Steel wheel rollers other than vibrating shall be capable of exerting a force of not less than 250 psi of width of the roller. Vibrating steel wheel rollers shall have a minimum weight of 6 tons.
- F. Pneumatic-tired rollers shall have smooth tread tires of equal size that will provide a uniform compaction pressure for the full width of the roller and shall be capable of exerting a ground pressure of at least 80 psi.

3.02 SAWCUTTING, REMOVAL, AND PREPARATION OF EXISTING PAVEMENT

- A. Existing asphalt pavement to be removed shall be cut by a wheel cutter or other device capable of making a neat, reasonably straight and smooth cut without damaging adjacent pavement that is not to be removed.
- B. The existing pavement shall be saw cut and trimmed after placement of required base course material and just prior to placement of asphalt concrete for pavement replacement, and the trimmed edges shall be painted with a coating of prime coat immediately prior to constructing the new abutting asphalt pavements.
- C. All existing aggregate base material and asphalt concrete removed, and any excess new material shall be hauled away from the project site and legally disposed of by the Contractor.

3.03 APPLICATION

- A. Conditioning of Existing Surface: When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross section as directed by Owner.
- B. Paint contact surfaces of curbing, gutters, manholes, and other structures with a thin, uniform coating of asphalt concrete tack/primer coating emulsion before placing the asphalt concrete mixture against them.

3.04 MIXING

- A. Combine aggregates in the mixer in the amount of each fraction of aggregates required to meet the job mix formula. The asphalt concrete material shall be measured or gauged and introduced into the mixer in the amount specified by the job mix formula.
- B. After the required amounts of aggregate and asphalt concrete material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles is secured.
- C. The asphalt concrete material and aggregate for pugmill mixtures shall be introduced into the mixer within 35°F of each other. Temperature of pugmill mixtures shall be controlled between 225 and 300°F.
- D. Material delivered to the paver shall not be less than 225°F.

3.05 SPREADING AND FINISHING MIX

- A. The mixture shall be laid upon an approved surface, spread and struck off to the grade and elevation established. Use asphalt concrete pavers to distribute the mixture either over the entire width or over such partial width as may be practicable.
- B. The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches.
- C. Where paving operations are on the present traveled roadway, and where the thickness of pavement course being placed is greater than 1 inch, the Contractor shall arrange his paving operations so that there will be no exposed longitudinal joint between adjacent travel lanes at the end of a day's run.
- D. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and luted by hand tools. For

such areas the mixture shall be dumped, spread, and screeded to give the required compacted thickness.

- E. Transport and place asphalt concrete mixture on the roadway in a manner that will minimize segregation. Remove segregated areas behind the paver immediately and replace the segregated material with specification material before the initial rolling has taken place. The removal and replacement of nonspecification material or unacceptable work shall be accomplished at no additional expense to the Contractor.
- F. Place asphalt concrete material as continuously as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Owner. Form transverse joints by cutting back on the previous run to expose the full depth of the course. When directed, use a coat of asphalt concrete tack/primer emulsion coating on contact surfaces of all joints just before additional mixture is placed against the previously rolled material.

3.06 COMPACTING MIX

- A. After the asphalt concrete mixture has been spread and struck off, and surface irregularities have been adjusted, thoroughly and uniformly compact mixture by rolling.
- B. Roll surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.
- C. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition.
- D. Begin rolling at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping one half the roller width, gradually progressing to the crown of the road. When paving in echelon or abutting a previously placed lens, roll the longitudinal joint first, then follow regular rolling procedure. On superelevated curves, begin rolling at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.
- E. Continue rolling until all roller marks are eliminated and the minimum density specified has been obtained.
- F. Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the asphalt concrete mixture.
- G. To prevent adhesion of the mixture to the rollers, keep wheels properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.
- H. Along forms, curbs, headers, walls, and other places not accessible to the rollers, thoroughly compact mixture with herd tampers or with mechanical tampers.
- I. Remove mixture that becomes loose and broken, mixed with dirt, or is in any way defective, and replace with fresh hot mixture; compact to conform with the surrounding area.

3.07 ACCEPTANCE REQUIREMENTS

- A. Surface Tolerance: The variation between any two contacts with the surface shall not exceed 1 inch vertical in a 10 foot length. Correct all humps or depressions exceeding the specified tolerance by removing defective work and replacing it with new material at no additional expense to the Owner.
- B. Density: Acceptable density of the in place asphalt concrete pavement shall be 95 percent of the optimum values as determined from the job mix formula. Field sampling and density determinations shall be made in accordance with AASHTO T230 68, or an acceptable nuclear procedure.
- C. A uniform compacted thickness shall be obtained for each course equal to or greater than the design thickness shown. Individual tests shall not vary by more than plus or minus ¼ inch.
- D. Mix Tolerances: The following tolerances for the job mix formula will be allowed per single test:

Sieve Designation	Percent Passing
No. 8 and larger sieves	+ 8
Smaller than No. 8 to larger than No. 200 sieve	+ 6
No. 200 sieve	+ 3
Asphalt content, weight percent total mix	+ 0.5

3.08 FIELD QUALITY CONTROL

- A. Placement
 - 1. Place the mixture on the roads, pavements, or walks at a temperature not less than 225°F.

- B. Tests
 - 1. The type and size of the samples shall be suitable to determine conformance with stability, density, thickness, and other specified requirements. Use an approved power saw or core drill for cutting samples. Furnish all tools, labor, and materials for cutting samples, testing, and replacing the pavement where samples were removed. Take a minimum 1 sample per 200 tons of asphalt concrete placed.

- C. Acceptance Criteria
 - 1. General: Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement as well as the implementation of the Contractor's Quality Control plan and test results:
 - a. Stability
 - b. Flow
 - c. Air Voids
 - d. Mat Density
 - e. Joint Density
 - f. Thickness
 - 2. Smoothness
 - 3. Grade
 - 4. Aggregate Gradation

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING – VEHICULAR

PART 1 – GENERAL

1.01 SUMMARY

- A. Work included:
 - 1. Driveways
 - 2. Roadways / Vehicular Concrete
 - 3. Parking lots/spaces
 - 4. Curbs and Gutters
 - 5. Cross gutters

1.02 REFERENCES

- A. Section 32 13 16 – Decorative Concrete Paving
- B. Section 32 13 73 – Joint Sealants for Paving Contraction Joint Sealing

1.03 DEFINITIONS

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

1.04 SUBMITTALS

- A. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer, and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers

Certificates shall include:

- C. Material Test Reports: For each of the following:
 - 1. Aggregates.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

- E. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.
- F. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
 - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving subcontractor.
 - e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

1.06 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- 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 and 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.02 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.
- F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.
- H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.
- I. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- J. Deformed-Steel Wire: ASTM A 496/A 496M.
- K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.
- L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M,

- Grade 60 (Grade 420), plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- O. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A 780.

2.03 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150, gray portland cement Type II or Type V.
Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4M, uniformly graded. Provide aggregates from a single source.
 - 1. Aggregate Sizes: 3/4 to 1 inch (19 to 25 mm) nominal.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Elementis Pigments.
 - e. Hoover Color Corporation.
 - f. Lambert Corporation.
 - g. LANXESS Corporation.
 - h. QC Construction Products.
 - i. Scofield, L. M. Company.
 - j. Solomon Colors, Inc.

- k. Stampcrete International, Ltd.
- l. SureCrete Design Products.
- 2. Color: As selected by Architect from manufacturer's full range.

2.04 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

2.05 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

2.06 DETECTABLE WARNING MATERIAL

- A. Reference specification section 32 17 26 – Tactile Warning Surfacing

2.07 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type F; colors complying with FS TT-P-1952.
 - 1. Color: As indicated on plans.
- B. Glass Beads: AASHTO M 247, Type 1

2.08 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.

2.09 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4500 psi
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.
 - 2. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
 - 3. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions and as approved by Caltrans
- F. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would

- otherwise be used, by not less than 40 percent.
- G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
- C. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
1. For concrete batches larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. Yd.
 2. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tones).
 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Section 31 20 00 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating

according to ASTM D 3963/D 3963M.

- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

3.05 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet and at locations as indicated on the plans, unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving.
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 - 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints

where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete.
Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.07 FLOAT FINISH

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Medium Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.08 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

3.09 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 3/4 inch
 2. Thickness: Plus 3/8 inch, minus 1/4 inch
 3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/2 inch.
 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 6. Vertical Alignment of Dowels: 1/4 inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 8. Joint Spacing: 3 inches.
 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 10. Joint Width: Plus 1/8 inch, no minus.

3.10 PAVING MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a

minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.11 WHEEL STOPS

- A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.
- B. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine

compliance of replaced or additional work with specified requirements.

- I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 13 16

DECORATIVE CONCRETE PAVING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Pedestrian Concrete paving, bands, curbs and walls
 - 2. Reinforcement
 - 3. Surface finish
 - 4. Special curing
- B. Related sections:
 - 1. Section 31 20 00 – Earth Moving for backfilling and compacted fill for paving
 - 2. Section 32 13 73 – Joint Sealants for paving contraction joint sealing
 - 3. Section 32 13 13 – Concrete Paving - Vehicular

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Samples: Provide a concrete sample of each sample specified for review and approval by Owner prior to installation. Provide additional samples until finish it is considered acceptable by the Owner, at no additional cost to the Owner. The approved sample shall serve as a standard of appearance for the final work to be produced and shall remain on site until all concrete has been reviewed and approved by the Owner.
- C. Other Action Submittals:
 - 1. Design Mixtures: For each concrete paving mixture, include alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

- A. Ready-Mix Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

1.4 TESTS

- A. Testing and analysis will be performed under provisions of Section 014000 – Quality Requirements.
- B. Make available proposed mix design of each class of concrete to appointed firm for review prior to commencement of work.
- C. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- D. Tests of cement and aggregates will be performed to ensure conformance with specified requirements.
- E. Three concrete test cylinders will be taken for every 75 or less cubic yards of each class of concrete placed each day.

- F. One additional test cylinder will be taken and be cured on site under same conditions as concrete it represents.
- G. One slump test will be taken for each set of test cylinders taken.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials of same type, brand, and source throughout project:
 - 1. Cement: ASTM C 150 Normal Type 1, gray, Portland cement
 - 2. Blended Hydraulic Cement: ASTM C 595, cement
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.
- C. Water: Clean, potable and complying with ASTM C 94/C 94M
- D. Air-Entraining Admixture: ASTM C 260
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water soluble chloride ions by mass of cementitious material.
- F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures: color stable, nonfading and resistant to lime and other alkalis.
 - 1. Color: As indicated

2.2 FORM MATERIALS

- A. Conform to ACI 301
- B. Wood or Steel form material, profiled to suit conditions.

2.3 STEEL REINFORCEMENT

- A. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, uncoated finish, fabricated from as-drawn steel wire into flat sheets.
- C. Reinforcing Bars: ASTM A 615/A 615M; deformed, uncoated finish
- D. Plain-Steel Wire: ASTM A 82/A 82M.
- E. Tie Wire: Annealed steel, minimum 16 gage size
- F. Dowel Bars: ASTM A 615/A, 615M, plain-steel bars. Cut bars true to length with ends square and free of burrs, uncoated finish.
- G. Bar Supports: Bolster, chairs, spacers, and other devices for spacing, supporting and fastening bars, welded wire reinforcement, and dowels in place. Manufacturer bar supports according to CRSI's Manual of Standard Practice from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, ½ inch long.

2.5 ACCESSORIES

- A. Pre-emergent Herbicide: Surflan
- B. Curing Compound: FS TT-C-800, Type 1, 30 percent solids; ASTM C309, Ashford Formula
- C. Integral Color (Non-Immersion Conditions): Davis Colors or approved equal.
- D. Chemical Surface Retarder: 'Top cast' by Grace Construction Products or approved equal.
- E. Liquid Surface Sealer: 'HLQ-125' by SINAK Corporation or approved equal.
- F. Patch Bond: Weld-Crete or approved equal.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips

2.7 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
 - 1. Color: As indicated
- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint
 - 1. Color: As indicated

2.8 CONCRETE MIXTURES

- A. Mix concrete in accordance with ASTM C94.
- B. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
 - 1. Compressive Strength (28 days): 3,250 psi
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.57
 - 3. Slump Limit: 4 inches, plus or minus 1 inch
 - 4. Air-Content: 6 percent plus or minus 1.5 percent
- C. Chemical Admixtures:
 - 1. Use accelerating admixtures in cold weather only when approved by Owner. Use of Admixtures will not relax cold weather placement requirements.
 - 2. Use set-retarding admixtures during hot weather only when approved by Owner.
- D. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 pound/cu. yd.
 - 1. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.
 - 2. Add air entraining agent to concrete mix for concrete work as necessary.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the work.

PART 3 – EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Verify compacted subgrade and/or base is ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Beginning of installation means acceptance of existing conditions.
- D. Moisten base to minimize absorption of water from fresh concrete.
- E. Notify Owner minimum 24 hours prior to commencement of concreting operations.
- F. Proof-roll prepared sub-base surface below concrete paving to identify soft pockets and areas of excess yielding.
- G. Remove loose material from compacted sub-base surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement. Obtain layout approval prior to pour.
- B. Assemble form work to permit easy stripping and dismantling without damaging concrete. Use of permanent screed is permissible. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- C. Place joint fillers vertical in position, in straight lines. Secure to form work during concrete placement.

3.3 REINFORCEMENT

- A. Place reinforcement. Comply with CRSI's Manual of Standard Practice for fabricating, placing, and supporting reinforcement.
- B. Interrupt reinforcement at expansion joints.
- C. Place reinforcement to achieve slab and curb alignment as detailed.
- D. Provide dowelled joints at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.

3.4 JOINTS

- A. General: Form construction, isolation and expansion joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct control joints at maximum 5 foot intervals of paving and at right angles to centerline unless otherwise indicated. Align curb, gutter and sidewalk joints when possible.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects and where indicated.
- D. Expansion Joints: Place expansion joints at 20 foot intervals unless otherwise shown to correct elevation and profile. Place expansion joints between paving components and building or other appurtenances.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8 inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Comply with ACI 301 requirements for measuring, mixing, transporting, placing and consolidating concrete.
- B. Ensure reinforcements, inserts, embedded parts and formed joints are not disturbed during concrete placement.
- C. Deposit and spread concrete in a continuous operation between predetermined construction joints. Do not push or drag concrete into place or use vibrators to move concrete into place. Do not break or interrupt successive pours such that cold joints occur.
- D. Place concrete to pattern indicated.
- E. Coordinate pours of integral color concrete to ensure consistency of color throughout. Color inconsistency will not be accepted.
- F. For walls, settle concrete by vibration to eliminate honeycombs. Concrete with visible honeycombs will be rejected.
- G. Screed paving surface with a straightedge and strike off.
- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Tolerances in horizontal alignment of hardscape elements, such as paving edges, joints and walls shall not exceed ¼ inch in 10 feet, or ½ inch in 50 feet.

3.6 FINISHING

- A. See plan for finishes and finish locations
- B. Curbs and gutters: Light broom, unless otherwise specified.
- C. Finishes:
 - 1. General: Do not add water to concrete surfaces during finishing operations. Compact and tamp concrete (unless Retardant Finish is specified), to bring 3/8 inch of mortar to surface, float with wood screeds and floats only and apply following finishes after surface floating. Do not use steel or any plastic screeds, floats or "Fresno" for initial floating and screeding operations. For Retardant Finish, the concrete shall be placed and consolidated so as to completely fill all spaces in the forms; however, tamping will not be permitted because the aggregate must remain near the surface for later exposure.
 - 2. All concrete finishes shall be as listed on the Drawings.

3.7 CONCRETE PROTECTION, CURING AND SEALING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pound/square feet x h before

- and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
 - E. Curing Methods: Cure concrete by moisture-retaining-cover curing, curing compound or a combination of these.
 - F. Concrete Surface Sealer: All concrete paving shall be sealed with a clear, penetrating concrete sealer. If efflorescence or alkali-staining is evident after the concrete has cured, lightly wash the surface with a mild muriatic acid solution (usually a 10:1 dilution) that has been thoroughly rinsed with water and cleaned with diluted Lithochrome Floor Cleaner by Davis Colors or approved equal. Rinse again and dry thoroughly. After concrete mix has cured for at least one month, the concrete surface shall be thoroughly washed with fresh, clean water. After surface is thoroughly dried, apply 'HLQ-125' as manufactured by SINAK Corporation, or approved equal, per manufacturer's specifications.

3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: $\frac{3}{4}$ inch
 - 2. Thickness: Plus $\frac{3}{8}$ inch, minus $\frac{1}{4}$ inch
 - 3. Surface: Gap below 10 foot-long, unlevelled straightedge not to exceed $\frac{1}{2}$ inch
 - 4. Joint spacing: 3 inches
 - 5. Contraction Joint Depth: Plus $\frac{1}{4}$ inch, no minus
 - 6. Joint Width: Plus $\frac{1}{8}$ inch, no minus

3.9 PAVEMENT MARKING

- A. Allow concrete paving to cure a minimum of 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 millimeters.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Owner's Representative.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Cold-applied joint sealants
 - 2. Hot-applied joint sealants

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturer's, eight samples of materials that will contact or affect joint sealants. Use manufacturer's standard test method to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants of joint substrates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint sealant product indicated
- B. Samples: For each kind and color of joint sealant required
- C. Pavement Joint Sealant Schedule - Include the following information:
 - 1. Joint sealant application, joint location and designation
 - 2. Joint sealant manufacturer and product name
 - 3. Joint sealant formulation
 - 4. Joint sealant color

1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates
- B. Product test reports
- C. Preconstruction compatibility and adhesion test reports

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021
- B. Preinstallation Conference: Conduct conference at project site

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

2.2 COLOR APPLIED JOINT SEALANTS

- A. Single Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 “Product Requirements.”
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but not limited to the following:
 - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone
 - b. Dow Corning Corporation; 888
 - c. Pecora Corporation; 301 NS
- B. Single Component, Self Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 “Product Requirements.”
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but not limited to the following:
 - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone SL
 - b. Dow Corning Corporation; 890 SL
 - c. Pecora Corporation; 300 SL
- C. Multi-component, Pourable, Traffic Grade, Urethane Joint Sealant for Concrete: ASTM C 920. Type M, Grade P, Class 25, for Use T. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 “Product Requirements.”
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but not limited to the following:
 - a. Pecora Corporation; Urexpan NR-200

2.3 JOINT SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold and Hot Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- B. Round Backer Rods for Cold Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold and Hot Applied Joint Sealants: ASTM D 5249, Type 2; of thickness and width required to control joint sealant depth, prevent bottom-side adhesion of sealant and fill remainder of joint opening under sealant.

2.5 PRIMERS

- A. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Comply with joint sealant manufacturer’s written installation instructions for

- products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - C. Joint Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
 - D. Install Joint Sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint sealant backings
 - 2. Do not stretch, twist, puncture, or tear joint sealant backings
 - 3. Remove absorbent joint sealant backings that have become wet before sealant application and replace them with dry materials.
 - E. Install Joints Sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - F. Tooling of Nonsag Joint Sealants: Immediately after joint sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - G. Provide joint configuration to comply with joint sealant manufacturer's written instructions unless otherwise indicated.
 - H. Clean off excess joint sealant or sealant smears adjacent to joints as the work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1 – GENERAL

1.01 SUMMARY

- A. Related Documents: Provisions of the Contract, including Conditions of the Contract, Drawings and Division 1 – General Requirements of the Specification, apply to this Section.
- B. Description: Pavement marking is indicated by Contract Documents and shall include work necessary and incidental to completion and performance of the work.
- C. Included: Pavement marking includes, but is not limited to, following:
 - 1. Roadway and parking pavement markings.

1.02 SYSTEM DESCRIPTION

- A. Codes and Standards: Meet requirements of following, except to extent of most stringent requirements of Contract Documents and of codes and regulations of public authorities bearing on performance of the work:
 - 1. FHA, USDOT – Manual on Uniform Traffic Control Devices for Streets and Highways.
 - 2. FHA, USDOT – Standard Alphabets for Highway.
 - 3. CALTRANS – Standard Specifications for Traffic Stripes and Pavement Markings (Section 84) Thermoplastic and Painted Types.
 - 4. USDOJ – Americans with Disabilities Act (ADA).
 - 5. CBC – California Building Code 2019
 - 6. Handicapped people accessibility codes and regulations of public authorities bearing on performance of the work.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall meet requirements of documents specified in Paragraph – Codes and Standards, of this Article.

PART 2 - PRODUCTS

2.01 PAINT

- A. General: Paint material shall meet requirements of applicable standards specified in Paragraph – Codes and Standards, of this Section.
- B. Applications:
 - 1. Size and color per Drawings:
 - a. Auto parking spaces.
 - b. Roadway and paved areas traffic control edge marking where indicated on Drawings.
 - 2. Accessible symbol, size, color, and locations as indicated on Drawings.

2.02 THERMOPLASTIC PAVEMENT MARKING

- A. General: Thermoplastic pavement marking material shall meet requirements of applicable standards specified in Paragraph – Codes and Standards, of this Section.
- B. Applications:
 - 1. Traffic control symbols, such as turning arrows, lettering and like items. Size, color, and locations as indicated on Drawings.

2. Stop bar, 12 inches wide, adjacent to stop signs extending from edge of pavement to roadway centerline.
3. Crosswalk, 12 inches wide, extending from one edge of traveled way to the other.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General: Examine areas and conditions under which pavement marking is to be installed for compliance with requirements of Contract Documents and to determine if conditions affecting performance of pavement marking are satisfactory. Do not proceed with work until unsatisfactory conditions have been resolved.

3.02 APPLICATION

- A. General: Apply pavement markings meeting requirements of Contract Documents, as indicated by final reviewed submittals for the work and meeting instructions and recommendations of paint material manufacturers.
- B. Paint Markings:
 1. Meet requirements of applicable standards specified in Paragraph – Codes and Standards, of this Section.
 2. Surface shall be dry and free from dirt, grease, oil, acids or other foreign matter. Surface shall be thoroughly cleaned immediately before paint application.
 3. Suitable layouts and lines shall be spotted to serve as guides for paint application.
 4. Paint shall be mixed and applied in meeting instructions of paint manufacturer. Thinning will not be permitted.
 5. Application shall be with a marking machine at a rate of 105 to 115 square feet per gallon.
 6. Striping that does not meet specifications shall be removed in a manner not to damage pavement, including defacement of surface and texture. Damaged pavement shall be repaired as acceptable to Architect and/or Owner at no addition to Contract Sum.
 7. Parking spaces for the disabled shall be marked according to CBC Section 1129B.5.
 8. Accessible painted lines and markings on pavement shall be 3" minimum wide and blue in color equal to Color No. 15090 per Federal Standard 595B.
- C. Thermoplastic Markings: Meet requirements of applicable standards specified in Paragraph – Codes and Standards, of this Section.
- D. Tactile Warning Lines: Shall be in conformance to CBC Section 1133B.8.3 and 1133B.8.4.

END OF SECTION

SECTION 32 17 26
TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tactile and detectable warning tiles for pedestrian walking surfaces.

1.02 REFERENCE STANDARDS

- A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
 - 2. Samples: For each product specified provide two samples, 8 inches (203 mm) square, minimum; show actual product, color, and patterns.
 - 3. Shop Drawings: Submit plan and detail drawings. Indicate:
 - a. Locations on project site. Demonstrate compliance with referenced accessibility standards.
 - b. Sizes and layout.
 - c. Pattern spacing and orientation.
 - d. Attachment and fastener details, if applicable
- B. Informational Submittals:
 - 1. Warranty: Submit manufacturer warranty; complete forms in Owner's name and register with manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Installer to provide written certification demonstrating they meet the requirements for installation set by the product manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40- and 90-degrees F (4 and 32 degrees C).

1.06 PROJECT CONDITIONS

- A. Weather Limitations for Adhesive Application:
 - 1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

1.07 WARRANTY

- A. Plastic Tiles: Provide manufacturer's standard five-year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General
 - 1. Detectable warnings surfaces shall comply with CBC Section 11B-705.1.
 - 2. Detectable warning surface color shall conform to 33538 SAE AMS-STD-595A for locations at curb ramps, islands, or cut-through medians. Color used shall contrast visually with that of adjacent walking surfaces, either light-on-dark, or dark-on-light. CBC Sections 11B-705.1.1.3
 - 3. Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact. CBC Section 11B-705.1.1.4.

2.02 TACTILE AND DETECTABLE WARNING DEVICES

- A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory applied removable protective sheeting.
 - 1. Installation Method: Cast in place replaceable.
 - 2. Shape: Rectangular.
 - 3. Width: 36 inches (914 mm)
 - 4. Pattern: In-line pattern of truncated domes complying with ADA Standards.
 - 5. Edge: Square.
 - 6. Joint: Butt.
 - 7. Color: Shall conform to 33538 SAE AMS-STD-595A.

2.03 ACCESSORIES

- A. Fasteners: ASTM A666, Type 304 stainless steel
 - 1. Type: Countersunk, color matched composite sleeve anchors
 - 2. Size: 1/4-inch (6.35 mm) diameter and 1-1/2 inches (38 mm) long.
- B. Adhesive: Type recommended and approved by dome manufacturer.
 - 1. Adhesives shall meet VOC and chemical component limits of South Coast Air Quality Management District (SCAQMD) Rule No. 1168 and CAL-Green Table 5.504.4.1 Adhesive VOC Limit requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
 - 1. Examine work area with installer present.
 - 2. If existing conditions are not as required to properly complete the work of this section, notify Architect.
 - 3. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
 - 1. Do not install when ambient or substrate temperature has been below 40 degrees F (4 degrees C) during the preceding 8 daylight hours.
- B. Install units fully seated to substrate, square to straight edges and flat to required slope.

3.03 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. When installing multiple adjacent units, leave a 3/16-inch (5 mm) gap between units to allow for expansion.
- B. Tamp and vibrate units as recommended by manufacturer.
- C. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.04 INSTALLATION - SURFACE-APPLIED DOMES

- A. Install by method described in manufacturer's written instructions.
- B. Drill holes in surface to match pattern as required by Authorities Having Jurisdiction.
- C. Insert adhesive into hole.
- D. Press assembly into surface.

3.05 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

SECTION 32 80 00

IRRIGATION

PART 1 – GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions, Special Conditions, and Division 1 are an added part of THIS section and contract for this work and apply to this section as fully as if repeated herein.

1.02 SCOPE

- A. The work includes all services, labor, materials, transportation and equipment necessary to perform the work indicated on the Drawings and as specified. The General Conditions and Division 1 apply to this section as fully as if repeated herein.
 - 1. Related Work:
 - (a) Landscaping Section (329000)

1.03 SUBMITTALS

- A. Submit a list of all irrigation equipment to be used, manufacturer's brochures, maintenance manuals, guarantees and operating instructions.

1.04 GUARANTEE

- A. Furnish guarantee in accordance with general conditions, for a period of one (1) year from date of final acceptance - at conclusion of the Maintenance Period - on complete water irrigation system, including nonsettling of backfill in trenches which, if occurs, shall be corrected, including repairs and/or replacement of any material damaged thereby or therefrom.

1.05 OBSERVATION

- A. In all cases where observation of irrigation system work is required and/or where portions of work are specified to be performed under direction and/or observation of Architect or his representative, Contractor shall notify Architect at least three (3) working days in advance of time such inspection and/or direction is required.
- B. Observation will be required for the following parts of the work:
 - 1. Upon installation of sleeves.
 - 2. Upon installation and testing of main lines and lateral lines; when pipes are laid and are to be submitted to pressure tests. Do not cover any lines until they have been observed and approved.
 - 3. Upon installation and testing of valves, quick couplers, backflow preventer device, automatic controllers, and control valves and wires.
 - 4. When sprinkler system is completed, Contractor, in the presence of Architect, shall perform a coverage test to determine if coverage of water afforded the planting areas is complete and adequate. Contractor shall furnish all materials and perform all work required to correct any

inadequacies to cover.

5. Final observation and performance test shall be at the same time as final observation of the landscape work.

1.06 TESTING

All PVC main and lateral lines shall be subjected to a pressure test of 125 PSI for a period of four hours. All testing shall be in the presence of the Architect. Approval shall be received before backfilling any trench. Do not cover any lines until they have been observed and approved.

1.07 RECORD DRAWINGS

- A. Before final acceptance of work, Contractor shall provide a record set of drawings showing sprinkler system work.
 1. Any changes in location of items or type of installations from that shown on drawings shall be so indicated on the record drawings.
 2. Valves shall be numbered and corresponding numbers shall be shown on record drawings.
 3. All remote control valves, shut-off valves, quick coupler valves shall be located by measure dimensions. Dimensions shall be given to permanent objects and shall be to nearest one-half foot.
 4. On the inside surface of the cover of each Automatic Controller, prepare and mount a chart showing valves and sprinkler heads serviced by that particular controller. All valves shall be numbered to match operation schedule and drawings. Only those areas controlled by controller shall be shown. This chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. A photostatic print of this plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. This print shall be approved by the Architect and shall be hermetically sealed by plastic. This shall then be secured to inside of cover.
 5. Immediately upon installation of any buried pipe or equipment, Contractor shall indicate on the drawings locations of said equipment. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs and driveways.

1.08 GENERAL REQUIREMENTS

- A. Code Requirements shall be those of State and Municipal codes and regulations locally governing this work, providing that any requirements of the Drawings and Specifications, not conflicting therewith but exceeding the Code Requirements shall govern, unless written permission to the contrary is granted by the Landscape Architect.
- B. Extreme care shall be exercised in excavating and working in the area due to existing utilities. Contractor shall be responsible for damages caused by his operations.
- C. Connections shall be made at approximately locations shown on drawings. Contractor shall be responsible for minor changes caused by actual site conditions.

- D. Landscape headers shall be in place before installation of irrigation system.
- E. Scaled dimensions are approximate. Before proceeding with any work, Contractor shall carefully check and verify all dimensions.
- F. Plan locations of sub surface lines, valves, controller and pipelines are diagrammatic and indicate the spacing and relative locations of all installations.
- G. All lines shall have minimum clearance of 6-inches from each other, and from lines of other trades. Parallel lines shall not be installed directly over one another.
- H. Dielectric bushings shall be used in any connections with piping of dissimilar metal materials.
- I. Point of connection shall be approximately as shown on drawings. Connect new underground piping and valves and provide all flanges, adapters or other necessary fittings for connection.
- J. Permission to shut off any existing in-use water lines must be obtained 48 hours in advance, in writing from Owner. Contractor shall receive instructions from Owner, as to the exact length of time of each shut-off.
- K. Contractor shall acquaint himself with all site conditions.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Piping: Pipe sizes shown are nominal inside diameter unless otherwise noted.
 - 1. PVC Pressure Mainline Pipe Fittings:
 - (a) Pressure mainline piping for sizes 2-inch and larger shall be PVC Class 315.
 - (b) Pipe shall be made from an NSF approved Type 1, Grade 1, PVC compound conforming to ASTM Resin Specifications “D1784”. All piping must meet requirements as set forth in Federal Specifications PS-22-70, with an Appropriate Standard Dimension (S.D.R.) - (Solvent Weld Pipe).
 - (c) Pressure mainline piping for sizes 1-1/2 inch and smaller shall be PVC Schedule 40 with solvent welded joints.
 - (d) PVC solvent-weld fittings shall be Schedule 40, 1-2, 11-1 NSF approved conforming to ASTM Test Procedure D2466.
 - (e) Solvent cement and primer for PVC solvent weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.
 - (f) All PVC pipe must bear the following markings.
 - 1. Manufacturer’s Name
 - 2. Nominal Pipe Size
 - 3. Schedule or Class
 - 4. Pressure Rating in P.S.I.
 - 5. NSF (National Sanitation Foundation) Approval
 - 6. Date of Extrusion
 - (g) All fittings shall bear the manufacturer’s name of trademark, material designation, size, applicable I.P.S. Schedule and NSF Seal of Approval.

2. PVC Non-pressure Lateral Line Piping
 - (a) Non-pressure buried lateral line piping shall be PVC Schedule 40 with solvent-weld joints.
 - (b) Piping shall be made from NSF approved Type 1, Grade 1, PVC compound conforming to the ASTM Resin Specifications "D1785". All pipes must meet requirements as set forth in Federal Specifications PS-21-70.
 - (c) Except as noted in Paragraphs (a) and (b) of Section 2.01.A.1 (a) and (b), all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure mainline pipe and fittings as set forth in Section 2.01.A.1 of these specifications, (Primer not required).
 - (d) All unsized end run lateral lines shall be 3/4-inch PIPE.
- B. Fittings and Connections:
 1. Polyvinyl Chloride Pipe Fittings and Connections: Type II, Grade 1, Schedule 40, high impact molded fittings, manufactured from virgin compounds as specified for piping, tapered socket or molder thread type, suitable for either solvent weld or screwed connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable. Furnish fittings permanently marked with following information: Nominal pipe size, type and schedule of material, and National Sanitation Foundation (NSF) seal of approval. PVC fitting shall conform to ASTM D2464 and D2466.
- C. Automatic Control Wire:
 1. Electric wiring running from Controller to Automatic control valves shall be No. 12, solid, single conductor, copper wire, 4/64 inch insulation, 4/64 inch neoprene jacket, style BR (Direct Burial) or equal, color code wires to each valve, common wire shall be white.
- D. Automatic Controller:
 1. Controller shall be furnished and installed complete with all water, electrical and drainage services, ready for operation. Unit shall be electric, self-contained outdoor type, pedestal-mounted, or approved equal. See detail for controller enclosure.
 2. Unit shall have a minimum stations as shown on Irrigation Legend.
 3. Controller shall be the latest model of the particular manufacturer supplied.
 4. Unit shall be 120-volt, 60-cycle controller, be completely automatic and shall function optionally with or without the clock.
 5. Any station may be repeated independently in any 24 hours.
 6. Stations shall be adjustable from 1 to 59 minutes.
 7. Control panel shall be removable plug-in type.
 8. Mechanism shall be housed in sturdy, vandal-proof case, manufactured of 14-gauge steel, or case aluminum; furnished for maximum exterior protection.
 9. The clock and all working parts of the controller shall be contained within one protecting cover.
- E. Control Valves:
 1. Remote Control Valves shall be of all Plastic body. Valve shall be provided

with an adjustable flow control stem and shall be operable manually without electricity. See Details and Drawings.

- F. Valve Box:
 - 1. For remote control valves 9-1/2-inch x 16-inch x 11-inch rectangular box manufactured by Carson Industries #14129-12B with bolt down cover or approved equal. See Details and Drawings.
 - 2. For ball valve: 10-inch x 10'1/4-inch round, Carson Industries #910-12B with bolt cover or approved equal. Extension sleeve to be PVC-6-inch minimum size.
- G. Sprinkler Heads:
 - 1. Shall be as required on the drawings or approved equal.
- H. Ball Valves:
 - 1. Ball valve 1-inch size to 2-inch size shall meet ASTM standards with seals that are self-adjusting to compensate wear. Ball valves shall have molded micro-finish ball with low torque requirements to operate unit manually. Ball valve shall have a patented feature - "Preloaded" stem seal and impact resistant handles.
- I. Concrete footings:
 - 1. Shall be 2,000 psi concrete at 28 days.
- J. Backfill:
 - 1. Shall be clean fill soil.
- K. Contractor shall provide to the Owner:
 - 1. Two (2) Control Valve keys.
 - 2. Two (2) wrenches for removing each different type of sprinkler head.
 - 3. One (1) 48" tee wrench for operating gate valves.
 - 4. Six (6) quick coupler keys and six (6) hose bib assemblies.
 - 5. Five (5) keys for opening and locking each automatic controller.
- L. Backflow Preventer Assembly:
 - 1. The backflow preventer assembly shall consist of a backflow preventer unit and related components conforming to the governing code requirements. See details and drawing.
- M. Pressure regulator:
 - 1. Shall be bronze with screw fitting. See details and drawing.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS:

- A. Locations on drawings are diagrammatic and approximate only, and shall be changed and adjusted as necessary and as directed by Owner to meet existing conditions and obtain complete water coverage. Locate and stake all work and obtain approval of Landscape Architect before installations.
- B. Install and extend system as shown on drawings, and as necessary to carry out the intent of Drawings and Specifications.
- C. Locate lines, valves and other underground utilities and receive approval of Landscape Architect before digging trenches.

3.02 INSTALLATION OF IRRIGATION SYSTEM

- A. Excavation and Backfilling of Trenches:
1. Excavate trenches, prepare subgrade, and backfill to line and grade with sufficient room for pipe fittings, testing and inspecting operations. Do not backfill until pipe system has been subjected to hydrostatic test as specified.
 2. Depth of Trench:
Polyvinyl Chloride Pressure Line 18" minimum.
Polyvinyl Chloride Non-Pressure Line 12" minimum.
 3. Trenching through areas where topsoil has been spread:
(a) Deposit topsoil on one side of trench and subsoil on opposite side.
 4. Subsoil shall be free of all rocks over 1-inch in diameter, debris, and litter, prior to use as backfill where so indicated on detail.
 5. Repair any leaks and replace all defective pipe fittings until lines meet test requirements. Do not cover any lines until they have been inspected and approved for tightness, quality of workmanship and materials.
 6. Backfill trenches, after approval of piping, with suitable and approved material, tamping soil around pipe and thoroughly compacting all trench fills until 90% compaction has been achieved.
 7. Backfill material shall be approved soil, free from rocks and clods.
- B. Installation of Polyvinyl Chloride Pipe:
1. Because of the nature of plastic pipe and fittings, exercise caution in handling, loading and storing, to avoid damage.
 2. The pipe and fittings shall be stored under cover until using, and shall be transported in a vehicle with a bed long enough to allow length of pipe to lay flat so as not to be subjected to undue bending or concentrated external load at any point.
 3. Any pipe that has been dented or damaged shall be discarded until such dented or damaged section is cut and rejoined with a coupling.
 4. Trench depth shall be as specified above from the finish grade to the top of the pipe. The bottom of trench shall be free of rocks, clods, and other sharp-edged objects.
 5. Pipe ends and fittings shall be wiped with MEK, or equal, before welding solvent is applied. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. All field cuts shall be beveled to remove burrs and excess before fitting and gluing together.
 6. Pipe shall be snaked from side-to-side of trench bottom to allow for expansion and contraction.
 7. Center load pipe with small amount of backfill to prevent arching and slipping under pressure. Leave joints exposed for inspection during testing.
 8. No water shall be permitted in the pipe until inspections have been completed and a period of at least 24 hours has elapsed for solvent weld setting and curing.
 9. Plastic to metal joints: Solvent-weld, using solvent recommended by pipe manufacturer only.
 10. Plastic to Plastic Joints: Solvent-weld, using solvent recommended by pipe manufacturer only.
 11. Solvent-weld Joints: Assemble per manufacturer's recommendation.
 12. Thrust block shall be installed as per detail.
- C. Remote Control Wiring:

1. Direct Burial Control wire sizes: As shown and specified herein before.
 2. Provide one control wire and one common ground wire to service each valve in system. Provide 4-foot minimum expansion loop at each valve to permit removal and maintenance of valves.
 3. Install control wires and irrigation piping in common trenches wherever possible.
 4. Control Wire Splices: Allow only on runs of more than 300 feet, splices as follows:
 - (a) Strip off minimum of 2-1/2 inches of insulation from each wire.
 - (b) Twist on Scotchlock electrical spring connector, minimum four complete turns.
 - (c) Seal connector in epoxy resin.
 - (d) Tape completed splice with Scotch 33 electrical tape.
 5. Numbering and Tagging: Identify direct burial control wires from automatic valves to terminal strips of controller at terminal strip by tagging wire with number of connected valve.
- D. Automatic Controller:
1. Automatic Controller shall be installed as shown and directed. Controller shall be tested with complete electrical connections. Contractor shall be responsible for temporary power to controller for operation and testing purposes.
 2. Connections to control wiring shall be made within the pedestal of the controller. All wire shall follow the pressure main insofar as possible.
 3. Electrical wiring shall be in a rigid PVC plastic conduit from controller to electrical outlet. The Electrical Contractor shall be responsible for installing all wiring to the sub-panels, clocks, or elsewhere as required, in order to complete this installation. A disconnect switch shall be included.
 4. Controller shall have a master switch. It shall be possible to operate each valve manually, independent of clock of any other valve.
- E. Remote Control Valves:
1. Install valve boxes as shown on detail. Install no more than one valve per box. Brand valve number and controller letter on valve box lid.
- F. Valve Box:
1. Install valve boxes as shown on detail. Install no more than one valve per box. Brand valve number and controller letter on valve box lid.
- G. Sprinkler Heads:
1. All sprinkler heads shall be installed as per details shown.
 2. Nozzle size of all heads shall be adjusted to suit any particular conditions of the area. This shall be done after the system has been thoroughly tested, immediately after written notification by the Landscape Architect to do so.
- H. Quick Coupler Assembly:
1. Install all quick couplers as indicated on drawings and as directed by Owner. Set all valves plumb and true to finish grade and a maximum of 12-inches from paving, walks, headers or curbs and as shown on plans and as directed by Owner.
- I. Ball Valves:
1. Install where shown as detailed.
- J. Backflow Preventer:

1. Backflow preventer assembly shall be installed in accordance with manufacturer's specifications, located and as directed on drawings, and shall conform to all applicable code and ordinance requirements.
 2. Exact location and positioning shall be verified and approved on the site by Landscape Architect.
- K. Pressure Regulator:
1. If needed, shall be installed as per drawings and details. Verify final location With Landscape Architect.
- L. Installation of Anti-Drain Valves:
1. Anti-drain valves shall be installed in the riser assemblies of all sprinkler heads that do not have manufacturer installed anti-drain devices.
- M. Install quick couplers and remote control valves adjacent to walks and curbs in shrub planting areas. Install quick coupler valves no further than 170' apart.
- N. Sleeving:
1. Crossing of roads with irrigation pipe or wiring shall be avoided wherever possible. If a crossing must be made, Schedule 80 PVC sleeves shall be installed at a minimum depth of 30-inches below finish grade.
 2. Irrigation lines under other asphalt concrete or Portland concrete improvements (other than roads) shall be installed in Schedule 40 PVC sleeves at a minimum depth of 18-inches below finished grade.
 3. Sleeve sizes for irrigation lines shall be a minimum of two (2) times the size of the line it serves.
 4. Controller wires located under streets or other permanent improvements shall be installed in separate PVC sleeves and corresponding to type and depth as specified.

3.03 CLEAN-UP

- A. As project progresses, Contractor shall maintain all areas in a neat manner and remove unsightly debris as necessary. After completion of the project, Contractor shall remove all debris and containers used in accomplishing work. He shall sweep and clean all sidewalks, asphalt, and concrete areas adjacent to plantings.

END OF SECTION

SECTION 32 90 00

PLANTING

PART 1 – GENERAL

1.01 GENERAL CONDITIONS

- A. Drawings and General Provisions of Contract, including General and Supplementary conditions and Division 1 Specification sections apply to work of this section, and must be fully considered in connection therewith.

1.02 SCOPE

- A. The work includes all services, labor, materials, transportation and equipment necessary to perform the work indicated on the drawings and as specified herein and as required to complete properly the contract.
- B. Related Work:
 - 1. Irrigation (Section 32 80 00)
 - 2. Concrete Paving (Section 32 13 13)
 - 3. Concrete Paving Joint Sealant (Section 32 13 73)

1.03 SUBMITTALS

- A. See requirements in General Conditions, and Section 01340.
- B. Contractor shall submit a typewritten list with specifications of all feasible materials, including soil amendments, fertilizers, plant materials, etc., with quantities of each.
- C. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

1.04 DEFINITIONS OF TERMS

- A. "Planting Area" shall mean all areas to be planted with trees, shrubs, vines and/or groundcovers.

1.05 GUARANTEES AND REPLACEMENTS

- A. Plant Materials: Plants (15-gallon size and larger) shall be guaranteed to live and grow in healthy condition during the agreed upon 90 day maintenance period or until final acceptance (3.20 Part B). Plant material will continue to be guaranteed for one (1) year.
- B. Plant material smaller than 15-gallon size: Shall be guaranteed to live and grow in vigorous healthy upright condition for a minimum of one growing season after final acceptance of work.

- C. Replacement: All plants not healthy and in vigorous growing condition as determined by the Landscape Architect shall be replaced immediately. Plants used for replacement shall be the same kind and size as specified in the plant list. They shall be furnished, planted and fertilized as originally specified at no costs to Owner.

1.06 VERIFICATION OF EXISTING CONDITIONS

- A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, quantities, and grade elevations, and shall immediately inform the Landscape Architect of any discrepancies.
- B. Prior to the excavation for planting or placing of plant materials, the Contractor shall verify the location of all underground utility lines and other improvements, and take proper precautions to avoid damage to such improvements. In the event of conflict between such improvements and plant locations, the Contractor shall notify the Landscape Architect, and arrangements will be made for relocation as necessary. Failure to follow this procedure places upon the Contractor the responsibility for making any and all repairs for damage resulting from work as herein specified at his own expense.

1.07 PROTECTION OF EXISTING IMPROVEMENTS

During the construction and maintenance period, the Contractor shall take every precaution to protect and avoid damage to sprinkler heads, irrigation lines, drainage lines, and all other underground facilities and all paving, structures, fixtures, and existing plantings. The Contractor shall be held responsible for any and all damage to such improvements and shall completely repair or replace the same at no cost to the Owner.

1.08 INSTRUCTIONS AND OBSERVATION

- A. All changes and deviations to the plans and specifications shall be confirmed in writing via the Landscape Architect.
- B. The Contractor shall be available on call to make a joint observation with the engineer. The Contractor shall have sufficient work personnel available during normal working hours to correct deficiencies immediately upon request of the Landscape Architect. Such repair or re-work services are to be performed without interference of regular project schedule.
- C. Plants shall be subject to approval by the Owner's Representative at the place of growth and/or upon delivery to the site for quality, size and variety. Such approval shall not impair the right of observation and rejection at the site during progress of work for size, condition of root ball, latent defects, or injuries. Rejected plants shall be removed immediately from the site, unless otherwise approved by the Landscape Architect.
- D. Site observations herein specified shall be made by the Landscape Architect. The Contractor shall notify the Landscape Architect of a site observation at least 48 hours in advance of an observation. An observation will be made by the

Landscape Architect during office working hours on each of the steps or conditions listed below. The Contractor or his authorized representative shall be on site at the time of each observation. The Contractor will not be permitted to initiate the succeeding step of work until he has received approval to proceed by the Landscape Architect.

1. Pre-Construction Meeting: Immediately prior to the commencement of work of this section, Contractor shall receive approval of materials and equipment to be used, and methods of installation.
 2. Incorporation of soil conditioning and fertilizing into the soil: Soil tests performed by the licensed laboratory shall be submitted and paid for by the Contractor for agricultural suitability and approved by the Landscape Architect once rough grading has been completed, and prior to installing any plant material.
 3. Upon the completion of finish grading.
 4. Approval of all plant material quality.
 5. Layout of plant material.
 6. Pre-maintenance observation: When planting and all other indicated or specified work, except the Maintenance Period, has been completed. Acceptance and written approval shall establish beginning of the Maintenance Period. This is not a final observation or acceptance, and it does not relieve the Contractor from any of the responsibilities in the contract documents for this project.
 7. Final site observation at the completion of the specified maintenance period. This observation shall establish the beginning date for the guarantee period.
- E. Acceptance: Upon completion of the Final Observation and the work of this section, the Contractor will be notified in writing (1) whether the work is acceptable and (2) of any requirements necessary for completion and acceptance.

1.09 SUSPENSION OF WORK

- A. The Landscape Architect shall recommend to the Owner any necessity to suspend the work wholly, or in part, for such period or periods as he may deem necessary due to unsuitable weather, or such other conditions as are considered unfavorable for the reasonable performance of the work, or for such time as is necessary due to the failure on the part of the Contractor to carry out orders given or to perform any or all provisions of the contract.
- B. If it should become necessary to stop work for an indefinite period, the Contractor shall store all materials in such a manner that they will not become an obstruction nor become damaged in any way, and he shall take every precaution to prevent damage or deterioration of the work performed. The Contractor shall cover all open excavations and shall provide suitable drainage by opening ditches, planting pits, etc., and erect temporary structures where necessary.
- C. Grading, soil preparation, and planting work shall be performed only during periods when beneficial and optimum results may be obtained. If the moisture content of the soil should reach a level that working it would destroy the soil structure, spreading, grading and tilling operations shall be suspended until the moisture

content reaches acceptable levels and the desired results are attainable.

1.10 CERTIFICATIONS AND NOTICE OF DELIVERY OF MATERIAL

- A. The Landscape Architect shall be furnished with duplicate signed, legible copies of certificates and/or invoices stating the brand, grade, amount and quantity of each item for all soil, fertilizers, soil conditioners, plans and other materials. THE LANDSCAPE ARCHITECT MAY STOP WORK PROGRESS UNTIL CERTIFICATES ARE RECEIVED AND REVIEWED BY THE ENGINEER.
- B. The Contractor shall notify the Landscape Architect in advance when all materials are to be delivered and the manner of shipment, and shall furnish therewith an itemized list, in duplicate, of the actual quantity of material in each delivery, in order to ensure satisfactory coordination of delivery, and to expedite the required inspection at the point of delivery. The itemized list, in duplicate, for each delivery of plant material shall include invoices certifying that subject material has been inspected as required by the State Agricultural Code prior to acceptance or planting. Particular care, using approved equipment, shall be exercised to ensure safe loading, unloading, shipping and handling for all plantings from source to in-place locations indicated on the drawings.

1.11 PLANT MATERIALS

- A. Quantities for plant materials are shown per plan for convenience only and not guaranteed. Contractor shall check and verify count and supply sufficient number to fulfill intent of drawings.

1.12 INVOICE OF MATERIALS

- A. Upon delivery of materials and/or completion of all soil conditioning and grading, but prior to initiating planting operations, the Landscape Architect with the heretofore specified signed copies of required certificates, trip slips and invoices for soil preparation materials, shall invoice such material, comparing the total quantities of each material furnished against the total area to each operation. If the minimum rates of application have not been met, the Landscape Architect will require the distribution of additional quantities of these materials to fulfill the minimum requirements specified.
- B. After installation of plant materials, but prior to the pre-maintenance site observation, the Landscape Architect, with the heretofore specified signed copies of the required certificates and related items, shall invoice such material, comparing the total area and/or the amounts specified. If the minimum amounts have not been furnished, the Landscape Architect will require the installation of additional materials to fulfill the minimum requirements specified.
- C. A sample of the soil amendments shall be delivered to the Landscape Architect within 15 days after recording of the contract for submittal to a testing laboratory, along with specifications of each product. After soil amendments have been thoroughly mixed into the site, random samples of the mixed soil will be taken by the engineer and submitted to the soil laboratory for comparison to a control mix. Cost of the above testing by the soils laboratory shall be borne by the Contractor.

PART 2 – PRODUCTS

2.01 QUALITY

- A. All materials shall be of standard, approved, and first grade quality and shall be in prime condition when installed and accepted. All commercially processed and/or packaged materials shall be delivered to the site in the original unopened containers bearing the manufacturer’s guaranteed analysis.

2.02 SOIL AMENDMENT AND FERTILIZER – For Bid Purposes Only. All Soil shall be amended per Soil’s Report.

- A. Shall be a wood residual product derived from shavings of redwood, white fir and/or red fir, or cedar shavings. Amendment shall upon analysis contain at least 1.0% nitrogen (on a dry weight basis) with an ash content not to exceed 15%. A commercial grade product shall be used. Contractor shall supply Landscape Architect or his appointed representative with a sample of the proposed amendment accompanied by a laboratory analysis from an approved laboratory illustrating degree of compliance. Guarantee = wt/cu/yd. = 460# - 720#. Ammonic nitrogen = 1.0%. pH (less than 6.8). Salinity (total soluble salts = 3.0 MMHO). Density = 20# cu.ft. Properties = (gradation sieve size) - No. 6 - 95% minimum passing; No. 8 - 80% minimum passing; No. 35 - 30% minimum passing.

Organic Soil Conditioner

Humic Acids (from Leonardite)	40.00%
Tri-C Humate	

Per random sample of material / Not Guaranteed Analysis

Organic matter	40.00%
Carbon	40.00%
Nitrogen	0.05%
Phosphoric Acid	0.07%

Wetability - to be in compliance with standards as per American Society of Agronomy.

- B. Agricultural Grade Gypsum - Shall be a (Ca SO4 - H2O) calcium sulfate product - 94.3%. 90% shall pass a 50 mesh screen. Chemical reaction will remove Sodium attached to soil particles. Gypsum also loosens heavy clay soils through electro-chemical action. Control of dust during application is mandatory.

Shall be U.S. Gypsum, shall be equal to.

- C. Sulphur (Soil) - Shall be elemental sulphur (99.5%) commercially prepared so that 46.9% passes a 50 mesh screen.

Shall be Wil-Gro, Union Chemicals or Baker Industries, if not available, shall be equal to.

- D. Iron Sulfate - Iron shall be expressed as metallic - derived from sulfate - deep green (Fe SO4 H2O) . A minimum analysis of 20.0% and 98.3% retained on a 10 mesh screen.

Shall be Wilson & Geo. Meyer, or Wil-Gro. If not available, shall be equal to.

- E. Pre-plant or starter fertilizer shall be a commercial grade flowable fertilizer with - 1% nitrogen, 10% phosphorous pentoxide and 10% potassium sulfate. No Potassium Chloride is to be used. Organic nitrogen shall be from Cottonseed Meal and Urea. Phosphate available from superphosphate and Cottonseed Meal. Potash from sulfate of Potash and Cottonseed Meal.

Screen analysis: % retained on stacked screen - approximately 8 - mesh 24.2%; 20 - mesh 75.2%; 48 - mesh 0.2%. Available percentage weight of plant food:

Nitrogen	1.0% min.
Phosphoric acid	10.0% min.
Potash	10.0% min.

Shall be Wil-Gro, Bandini or Kellogg. If not available, shall be equal to.

- F. Post Plant Fertilizer / Soil Conditioner (Maintenance): Fertilizer (commercial) shall be a combination of natural organic Humate and inorganic granular fertilizers, free-flowing suitable for application with approved equipment and shall contain the following minimum available percentages by weight of plant food:

Nitrogen	6% min.
Phosphoric acid	2% min.
Potash (Soluble)	4% min.
Sulphur	5%
Humic Acids (from Leonardite)	20%
Humate (Minerals/organic matter/carbon)	75%

Shall be Tri-C 6-2-4 with 5% soil conditioner/fertilizer. If not available, shall be equal to.

Tri-C Humate – Concentrated organic soil conditioner with minimum 40% humic acids.

- G. Planting tablets shall be Tri-C Myco Paks, 7 grams.

Mycorrhizae: Tri-C Myco Paks (endo-ecto blend of mycorrhizal inoculum)

7 gram Pak Blend of endo-ecto mycorrhizal inoculum in “teabag”...Individual packets.

Application Rates and Usage for Individual Plants and Trees:

PRODUCT	Liner/4"	1 Gallon	5 Gallon	15 Gallon	24" Box	36" Box	48" Box
ENDO 120 GRANULAR	1-2 ml (pinch)	1 teaspoon	1 tablespoon	3 tablespoons	½ cup	1 cup	1½ cups
MYCO PAK ENDO-ECTO PACKETS	Use Granular	1 pak	2-3 paks	6-8 paks	10-12 paks	16-18 paks	10-22 paks

Mycorrhiza: Tri-C Myco Drench (endo-ecto blend of 13 mycorrhiza species)

Blend of 13 endo-ecto mycorrhizae species in dry soluble formulation. One pound per 200 gallons of water.

- H. Mycorrhizal inoculum Products.
Mycorrhiza Fungi Products: Mycorrhizal fungi form the foundation of ecosystem function in most terrestrial vegetation. The fungi will permeate the soil and interconnect the root systems, including different plant species.

Mycorrhizae: Tri-C Endo 120 (arbuscular mycorrhizal inoculum):

Note: Meets and exceeds Cal Trans specifications.

1 lb. (454 grams) contains approximately 60,000 living propagules

Screen analysis: (% retained) - approximately: 4 mesh = 1.3%; 8 mesh = 24.2%; 20 mesh = 74.0%; and 48 mesh 0.05%.

2.03 PLANT MATERIALS

- A. Nomenclature: Scientific and common names of plants herein specified shall conform with the approved names given in "a checklist of Woody Ornamental Plants of California," published by the University of California, College of Agriculture, Manual 32 (1963); "Flowering Plants in the Landscape", published by University of California Press (1982); and "Tropicals", Timber Press, Oregon (1988). See list of plant material on drawings.
- B. Labeling: Each group of plant materials delivered on site shall be clearly labeled as to species and variety. However, final determination of plant species and variety will be made by the Landscape Architect and whose decision will be final. All patented plants (cultivar) required by the plant list shall be delivered with a proper plant patent attached.
- C. Quality and Size: All plants shall be vigorous, of normal growth, free from diseases, insects, insect eggs, and/or exceed the measurements specified.
- D. Container Stock: Shall have grown in containers for at least six months, but not over two years. No container plants that have cracked or broken balls of earth when taken from the container shall be planted, except upon special approval. No trees with damaged roots or broken balls shall be planted.
- E. Pruning: At no time shall the plant materials be pruned, trimmed or topped prior to delivery, and any alteration on the site of their shape shall be conducted only with the approval and in the presence of the Landscape Architect.
- F. Inspection of Plant Materials: Required by City, County or State authorities, shall be a responsibility of the Contractor, and when necessary he shall have secured permits or certificates prior to delivery of plants at site.
- G. On-Site Inspection of Plant Materials: Plants shall be subject to inspection and approval or rejection at the project site at any time before or during progress of work for size, variety, condition, latent defects and injuries. Rejected plants shall be removed from the project site immediately.
- H. Rejection and Substitution: All plants not conforming to the requirements herein specified shall be considered defective, and such plants, whether in place or not, shall be marked as rejected and be immediately removed from the site of the work and replaced with acceptable plant materials. The plant materials shall meet all

applicable inspections required by law. All plants shall be the species, variety, size, age and condition as specified herein and/or as indicated on the drawings. Under no condition will there be any substitution of plant species, variety, or reduced size for those listed on the accompanying drawings, except with the express written consent of the Landscape Architect.

- I. Right to Changes: The Landscape Architect reserves the right to change the species, variety and/or sizes of plant material to be furnished, provided that the cost of such plant changes does not exceed the cost of plants in the original bid. The Contractor shall be notified and confirmed in writing prior to sixty (60) days before the planting operation has commenced. Changes in the size and/or variety of any plant to be furnished which involves a reduction or addition in cost shall be adjusted in the contract cost.
- J. Root Condition: The Landscape Architect reserves the right to inspect root condition of any species, particularly those grown from seed, and if found defective, to reject the plants represented by the defective sample.
- K. Protection: All plants at all times shall be handled and stored so that they are adequately protected from drying out, from wind burn, and from all other injury. All plants determined by the Owner's representative to be wilted, burned, or dried out, may be rejected, and removed from the site. The Contractor's on-site plant storage area shall be approved by the Owner's representative prior to the delivery of any plant materials.
- L. Samples: Typical samples, three each of all varieties and sizes (shrubs 5 gallon and under, trees 15 gallon and under) of all plant materials shall be submitted for inspection approval at the site a minimum of fifteen days prior to planting operations. Approved samples shall remain on the site and shall be maintained by the Contractor as standards of comparison for plant materials to be furnished. Samples will be incorporated into the work.

2.04 PRE-EMERGENT HERBICIDE

- A. Pre-Emergent herbicide shall be as determined by the Contractor.

2.05 WEED CONTACT HERBICIDE

- A. Weed contact herbicide shall be RoundUp.
- B. Weed abatement shall be as stated on plans.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. General: The areas to receive trees, shrubs, groundcover plantings and their respective requirements for fertilizing, soil conditioning, and other treatment shall be as defined on the drawings. Equipment necessary for preparation of the ground surface and for handling and placing all required material shall be on hand in good working condition. Work shall be performed only during periods when beneficial

results can be obtained.

- B. Clearing and Grubbing: Prior to ripping and tillage operations, all vegetation in the area to be planted shall be grubbed, raked, and cleared from the site. The ground surface shall be cleared of all material which has accumulated during construction and all material which might hinder proper grading, tillage, planting and subsequent maintenance operation. All grubbed materials and debris shall be lawfully disposed of off the site by the Contractor at his cost.
- C. Obstruction Below Ground: All subsurface rocks over 2" in diameter and other underground obstructions shall be removed to the depth necessary to permit proper fine grading, tilling, or planting according to plans and specifications. All abandoned utility lines uncovered or severed shall be cut below grade and capped or plugged with concrete. Explosives shall not be used for removal. When the location of utility lines is shown on the plans or has been made known to the Contractor, all damage to these lines shall be repaired by the Contractor in a manner approved by the Landscape Architect and affected utility.
- D. Deep Ripping: All areas (including slopes) to receive groundcover and shrubs shall be deep ripped and loosened to a depth of twelve (12) inches in all directions.

3.03 SOIL AMENDMENTS, FERTILIZING AND ROTOTILLING

- A. Contractor shall have a thorough standard soil test performed in three (3) different locations on the Site and completed by a licensed agronomic laboratory prior to and after leaching of salts and prior to any planting of plant material. The soils test shall include, but not be limited to, the testing of soil salt levels, nutrient levels, and soil percolation. Contractor shall be responsible for supplying amendments and fertilizers at the level indicated in the soils test report. **Contractor to provide a copy of the soil test and amendments to the Landscape Architect.**
- B. **Rate of application is for bidding purposes only.** Soil test may reduce or increase total soil amendment yardage. Adjustments (plus or minus) may be necessary. Contractor shall obtain at least two soil tests of rough grade at site and submit results to the Landscape Architect for interpretation and recommendation. Call Tri-C Enterprises at 800/927-3311 for soil kit.
- C. After the areas have been deep ripped, the following rates of soil amendment materials shall be evenly spread over all planting areas and shall be thoroughly scarified to an average depth of six inches by rototilling a minimum of two alternating passes. Amendment must be intimately blended with soil.

Soil amendment: 6 cubic yards per 1,000 sq. ft. to a depth of 8".

Tri-C Humate	50 lbs. Per 1,000 sq. ft.
Gypsum:	120 lbs. per 1,000 sq. ft.
Soil Sulphur:	10 lbs. per 1,000 sq. ft.
Iron Sulfate:	10 lbs. per 1,000 sq. ft.

Fertilizer (commercial) 1-10-10 shall be applied at the rate of 30 pounds per thousand square feet and scarified into the top two inches of finish grade. Fertilizer shall be applied after leaching operation.

- D. The thoroughness and completeness of the rototilling and incorporation of the soil amendments shall be acceptable to the Landscape Architect. Slopes 2:1 and steeper or as per the drawings omit soil conditioner application and tilling.
- E. Care shall be taken that the rate of application of water does not cause erosion or sloughing of soils.
- F. All depressions, voids, erosion scars and settled trenches generated by the deep watering shall be filled with amended soil and brought to finish grade.
- G. Apply Naiad Wetting Agent, Sarvon or equal 4 oz. per 1,000 s.f. at the first spray of soil amendments.

3.04 FINISH GRADING

- A. Finish grades shall be as indicated on civil plan.
- B. Finish grades shall be measured after the ground has been watered-in and mechanically compacted and settled. The final grade shall be within plus or minus 0.1 foot of the spot elevations and grade lines indicated on the Civil drawing.
- C. Ease top and toe of all existing slopes.
- D. All undulations and irregularities in the planting surfaces resulting from tillage, rototilling and all other operations shall be leveled and floated out before planting operations are initiated.
- E. The Contractor shall take every precaution to protect and avoid damage to sprinkler heads, irrigation lines, and other underground utilities during his grading and conditioning operations.
- F. Final finish grades shall insure positive drainage of the site with all surface drainage away from buildings, walls and toward roadways, drains and catch basins.
- G. Final grades shall be acceptable to the Landscape Architect before planting operations will be allowed to begin.
- H. Planting surfaces shall be graded with no less than 2 percent surface slope for positive drainage.
- I. All rock and debris shall be removed from planting areas and then from the site in accordance with the following criteria, 1" diameter in shrub areas.
- J. Finish grade shall be 2" below finish paving surface in shrub areas.

3.04 PLANTING INSTALLATION

- A. Timing: Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally acceptable practice.
- B. Layout of Trees: All trees (24" box size and larger) shall be placed in the landscape per the direction of the Landscape Architect prior to installation of irrigation system. The trees shall then be moved so that planting holes can be excavated and amended. The trees shall then be installed in their respective holes and positioned in the holes per direction of the Landscape Architect.
- C. Layout Planting: Locations shall be approved by the Landscape Architect. All container plants shall be set by the Contractor in their final location in their respective containers prior to digging holes and/or planting. All plant locations shall be checked for possible interference with existing underground utility lines.

- D. Backfill for Trees and Shrubs: Shall be as specified in section 2.03.
- E. Disposal of Excess Soil and Debris: All excess excavated subsoil, rocks and debris shall be legally disposed of off the site by the Contractor at his cost or utilized on the site as directed by and at the option of the Owner.

3.05 PLANTING

- A. Soil moisture level prior to planting shall be no less than horticulturally acceptable. The Contractor shall request approval of moisture, and if found to be insufficient for planting, the planting pits shall be filled with water and allowed to drain before starting any planting operations.
- B. All excavated holes shall have vertical sides with roughened surfaces and shall be of the minimum sizes indicated on drawings. Holes shall be in all cases large enough to permit handling and planting without injury or breakage of root balls or roots.
- C. Excavation shall include the stripping and stacking of all acceptable soil encountered within the areas to be excavated for plant pits and planting beds. Protect all areas that are to be trucked over and upon which soil is to be temporarily stacked pending its re-use for the filling of holes, pits and beds.
- D. Plants shall be removed from containers in such a manner that the ball of earth surrounding the roots is not broken, and they shall be planted and watered immediately after the removal from the containers.
- E. The plants shall be planted at approved locations with the heretofore specified amendments and soil planting backfill.
- F. Backfill shall be placed at the bottom of each hole and thoroughly watered and compacted to a depth so that when a plant is placed in the hole, its root crown is slightly above the established final grade, and unless otherwise noted shall be raised or replaced as directed by the Owner.
- G. Tri-C myco Paks (7 gm.) shall be placed in each planting hole next to rootball at the following rates and per the manufacturer's recommendations. See application rates, Section 2.02 G.
Random testing to verify planting pak installation shall be conducted by the Landscape Architect.
- H. No plant will be accepted if the rootball is broken or cracked, either before, during, or after the process of installation.
- I. All plants shall be thoroughly watered to the full depth of each planting hole immediately after planting.
- J. The Contractor shall be responsible for all surface and subsurface drainage required which may affect his guarantee of the trees, shrubs and vines.
- K. Maintenance and Irrigation:
 - 1. Maintenance shall be the responsibility of the Contractor. It is his responsibility to provide a full coverage irrigation system, be it either an automatic on-and-off timing system or a manual irrigation system. After moisture mulch has been applied, the mulch shall be allowed to set for one day. The slopes can then be irrigated. Number of gallons to be applied to the slopes will vary from day to day and system to system, depending on the rate of growth and climatic conditions encountered. The soil surface must be kept moist at all time.

3.07 PLANTER MULCH

- A. All shrub and groundcover areas shall be evenly covered with planter mulch to a depth of 2 inches. Mulch type shown on plans.

3.08 PRE-EMERGENT HERBICIDE

- A. Pre-emergent herbicide shall be applied to all shrub and groundcover areas only and in accordance with manufacturer's specifications. The Owner's representative shall be notified and present at the time of application.

3.09 POST FERTILIZATION

- A. All planted areas shall receive Sarvon, Naiad Wetting Agent or approved equal, 4 oz. per 1,000 s.f. 45 days after the start of the maintenance period.

3.10 GENERAL MAINTENANCE AND ESTABLISHMENT PERIOD

- A. General: Maintenance operations shall begin immediately after each plant is planted and shall be kept in a healthy, growing condition by watering, fertilizing, pruning, spraying, weeding and all other necessary operations of maintenance. All areas shall be kept free of weeds and noxious grasses and clean and free of rocks, clods, and debris. All paving and walks shall be kept clear, clean and washed down.
- B. Establishment Period: The establishment period shall begin on the date that the Landscape Architect inspects and gives written provisional acceptance of the work and shall be ninety (90) calendar days. The establishment period may be extended or shortened at the discretion of the Landscape Architect.
- C. Maintenance Operations: Plants shall be kept in a healthy, growing condition by watering, pruning, trimming, edging, fertilizing, restaking, pest control, spraying, weeding and all other necessary operations of maintenance. Planting beds shall be kept free of weeds, grass and other undesired vegetative growth. During the specified maintenance period, all plants that are dead or severely distressed shall be replaced immediately.
- D. Extended Maintenance: When, in the opinion of the Landscape Architect, there is improper maintenance, poor or unhealthy condition of plant materials, the Contractor shall be responsible for additional maintenance of the work at no additional cost to the Owner until all the work is acceptable.
- E. Protection: The Contractor shall be responsible for providing adequate protection of all planting areas against traffic or other use by erecting fencing or other acceptable means immediately after the planting is completed. Warning signs and barricades shall be placed in various high-traffic areas. Damaged areas shall be repaired immediately by the Contractor.
- F. Weeding and Cultivating: All areas shall be kept free of debris and weeds.
- G. Replacement: During the maintenance period, plants which die or which are in an unhealthy or badly impaired condition shall be replaced by the Contractor within fourteen (14) days after unsatisfactory condition is evident. No replacement of plantings shall be made in any season definitely unfavorable for planting. At the conclusion of the maintenance period, the Landscape Architect will make an inspection of the work to determine the condition of all plants. All unhealthy plants

shall be removed from the site and replaced with plants of the same kinds and sizes as originally specified. Such replacement shall be made in the same manner as specified for the original planting and at no extra cost to the Owner.

- H. Acceptance: At the conclusion of the maintenance period, an inspection shall be made by the Landscape Architect, upon written notice, requesting inspection before acceptance. Maintenance period shall continue until all deficiencies are corrected.

3.11 CLEAN-UP

- A. As the project progresses, Contractor shall maintain all areas in a neat manner and remove unsightly debris as necessary. After completion of project, Contractor shall remove all debris and containers used in accomplishing work. He shall sweep and clean all sidewalks, asphalt, and concrete areas adjacent to plantings.

END OF SECTION

**SECTION 33 05 00
INSTALLATION OF BURIED PIPE**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section includes placement of buried pipelines and connections.

1.02 RELATED WORK DESCRIBED ELSEWHERE

- A. Section 31 23 16 Trenching

1.03 SUBMITTALS

- A. Installation schedule.
- B. Product data for each type of warning tape.

PART 2 – MATERIALS

2.01 PIPE MATERIAL

- A. Refer to section on pipe by type.

2.02 ACCESSORIES

- A. Non-Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick.
- B. Detectable Warning Tape: Provide an inert polyethylene film detectable warning tape manufactured for marking and identifying underground utilities, 6 inches wide with a minimum metallic foil core of 0.35 mils and shall be reinforced, consisting of 5 mils total thickness.
- C. Continuously inscribe warning tape with a description of the utility; colored as follows:
 - 1. Red: Electric
 - 2. Yellow: Gas and dangerous materials
 - 3. Orange: Telephone and other communications
 - 4. Blue: Water systems
 - 5. Green: Sewer systems
 - 6. Purple: Reclaimed water systems
- D. Detectable wire: Tracer wire shall be provided when non-detectable warning tape is used for plastic piping. Insulated No. 12 copper tracer wire shall be buried with the pipe and ends brought to surface.

PART 3 – EXECUTION

3.01 DELIVERY AND TEMPORARY STORAGE OF PIPE

- A. Limit on-site storage to maximum of one week.
- B. Avoid damage to the pipe. If necessary, provide suitable supports.

3.02 HANDLING OF PIPE

- A. Lift pipes with handling beams or wide belt slings as recommended by the pipe manufacturer. Do not use cable slings.

3.03 SANITATION OF PIPE INTERIOR

- A. During laying operations, do not place tools, clothing or other materials in the pipe.

- B. When pipe laying is not in progress, close the ends of the pipe by a vermin-proof plug constructed in a manner to deter entry by children and prevent the entrance of animals and foreign materials.

3.04 PLACEMENT OF PIPE IN TRENCH

- A. Control water in trench per section 31 23 16.
- B. Lay pipes uphill if the grade exceeds ten percent (10%).
- C. Where pipe bedding material is detailed below the subgrade, place and compact the bedding.
- D. Cut a depression to accommodate the pipe bell and external joint filler form and spaces to permit removal of the pipe handling slings.
- E. Lower the pipe onto the bedding and install it to line and grade along its full length of firm bearing except at the bell and at the sling depressions. The tolerance on grade is one-quarter inch (1/4"). The tolerance on line is one inch (1").
- F. Proceed to complete the pipe embedment as specified in Section 31 23 16.
- G. The radius of curvature of the trench shall determine the maximum length of pipe section that can be used without exceeding the allowable deflection at a coupling. The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe. The manufacturer's printed installation guide outlining the radii of curvature that can be negotiated with pipe sections of various lengths shall be followed.
- H. Proper implements, tools and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the work. All pipe, fittings, valves and accessories shall be carefully lowered into the trench by means of handling beams, wide belt slings or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- I. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, nor any other method that may fracture the pipe or will produce ragged, uneven edges.
- J. The pipe and accessories shall be inspected for defects prior to the lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.
- K. When the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers or main drains, the obstruction shall be permanently supported, relocated, removed or reconstructed by the Contractor in cooperation with owners of such utility structures. Unless otherwise indicated, this work shall be performed at the Contractor's expense.

3.05 ASSEMBLING RUBBER RING JOINTS

- A. Clean the ends of the pipe to be joined of foreign material.
- B. Immediately prior to lowering each section of pipe into the trench, apply a nontoxic water soluble vegetable soap solution to the inside of the bell of the pipe in the trench and to the rubber gasket and spigot groove of the pipe to be installed. Stretch the rubber gasket into the groove of the spigot end of the pipe to be inserted and distribute it uniformly around the circumference.
- C. Without tilting the pipe to be installed, enter its spigot into the bell of the pipe in the trench. Use come-a-longs or pipe jacks to drive spigot end home horizontally. Maintain joint recess recommended by pipe manufacturer or made-up joint. Where deflections at joints are required for curved alignment, do not exceed the pipe manufacturer's recommended maximum joint opening on one side.

3.06 OPERATIONS INCIDENTAL TO JOINT COMPLETION

- A. Plan joint completion to accommodate temporary test bulkheads for hydrostatic testing.

3.07 PIPE EMBEDMENT

- A. Provide sufficient space along each side of the pipe and the trench wall per plans to observe that the embedment material fills all spaces below pipe spring line under the pipe haunches.
- B. Start the backfilling operations immediately after coating the field joints.

3.08 PIPELINE CLOSURE ASSEMBLIES

- A. Employ pipeline closure assemblies to unite sections of pipeline laid from opposite directions and to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations.

3.09 FLANGED CONNECTIONS

- A. Lubricate nuts and bolts with oil or graphite prior to installation.
- B. Coat flanges and non-stainless-steel bolts with bitumen as specified.
- C. Wrap flanges which connect with buried valves or other equipment with two layers of polyethylene film specified for the valves and equipment. Extend the wrap over the flanges and bolts and secure it around the adjacent pipe circumference with tape.

END OF SECTION

**SECTION 33 10 00
WATER DISTRIBUTION**

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes water-distribution piping and specialties outside the building for the water service.

1.02 RELATED DOCUMENTS

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

1.03 DEFINITIONS

- A. Water-Distribution Piping: Interior domestic-water piping.
- B. Water Service: Exterior domestic-water piping branch from service main to building.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - B. Piping specialties.
 - C. Water meters.
 - D. Valves and accessories.
- E. Coordination Drawings: For piping and specialties including relation to other services in same area. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- F. Field Quality-Control Test Reports: From Contractor.
- G. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- C. NSF Compliance: Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.06 DELIVERY STORAGE AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
 - 4. During storage: Use precautions for valves according to the following:
 - 5. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 6. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

7. Handling: Use sling to handle valves and if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
8. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
9. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside
10. Protect flanges, fittings, and specialties from moisture and dirt.
11. Store plastic piping protected from direct sunlight.
12. Support to prevent sagging and bending.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
- B. Notify Owner Project Manager not less than two weeks in advance of proposed utility interruptions.
- C. Do not proceed with utility interruptions without written permission.
- D. If utility interruption is for more than eight hours, provide temporary utility service.

PART 2 – PRODUCTS

2.01 GENERAL

- A. The following products shall be used as shown on the Drawings.

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, Class 350 rated working pressure, thickness Class 50, with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Grooved-End, Ductile-Iron Pipe: AWWA C151, with one or both ends with cut rounded grooves according to AWWA C606.
 1. Ductile-Iron, Grooved-End Fittings: ASTM A 47, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 2. Ductile-Iron-Piping Keyed Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.03 PIPE LINING

- A. Asphaltic Lining:
- B. Unless otherwise specified, pipe and fitting shall be lined with asphaltic materials as specified in AWWA C151.
- C. Cement mortar lining:

- D. Where specified, interior surfaces of pipe and fittings shall be cement mortar lined in accordance with AWWA C104. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalies.

2.04 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper. Copper Fittings: ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings.
- B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper. Copper Fittings: ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings.
- C. Bronze Flanges: ASME B16.24, Class 150, (DR14) with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.05 PVC PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 200, (DR14) with bell end with gasket and spigot end.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - b. Coating: Fusion bonded epoxy coating, both interior and exterior per AWWA C116.
- B. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and stainless-steel bolts.
 2. Coating: Fusion bonded epoxy coating, both interior and exterior per AWWA C116.

2.06 JOINING MATERIALS

- A. Transition Couplings:
1. Underground Piping, NPS 1-1/2 and Smaller: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
 2. Underground Piping, NPS 2 and Larger: AWWA C219, metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
 3. Aboveground Piping: Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
 4. Brazing Filler Metals: AWS A5.8, BCuP Series.
 5. Soldering Flux: ASTM B 813, water-flushable type.
 6. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.
 7. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.07 CORROSION-PROTECTION ENCASUREMENT

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, Polyethylene (PE) film, 0.008-inch minimum thickness, tube or sheet.

2.08 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Or equal.
- B. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 1. Minimum Working Pressure: 200 psig.
 2. End Connections: Mechanical joint or flanged.
 3. Interior Coating: Complying with AWWA C550.
- C. UL/FM, Cast-Iron Gate Valves:
 1. Manufacturers:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. Central Sprinkler Company.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Or equal.
- D. OS&Y, Rising-Stem Gate Valves: UL 262, FM-approved iron body and bonnet, bronze seating material, and outside screw and yoke.
 1. Minimum Working Pressure: 175 psig.
 2. End Connections: Flanged.
- E. Bronze Gate Valves:
 1. Manufacturers:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Or equal
- F. OS&Y, Rising-Stem Gate Valves: UL 262, FM-approved bronze body and bonnet, outside screw and yoke, and bronze stem.
 1. Minimum Working Pressure: 175 psig.
 2. End Connections: Threaded.

2.09 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine.
 1. Manufacturers:
 - a. Grinnell Corporation; Mueller Co.; Water Products Div.
 - b. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - c. McWane, Inc.; Kennedy Valve Div.
 - d. Or equal
- B. Tapping Sleeve: Cast- or ductile-iron or stainless steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
- C. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- D. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, triangular cap with lettering "WATER", bottom section with base of size to fit over valve, and approximately 5-inch-diameter barrel.

- E. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- F. Indicator Posts: UL 789, FM-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.010 CHECK VALVES

- A. AWWA Check Valves: As specified on the Drawings.
 - 1. Manufacturers:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Or equal.

PART 3 – EXECUTION

3.01 EARTHWORK

- A. Refer to Section 31 20 00.

3.02 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with keyed couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 2 Section "Utility Materials" for joining piping of dissimilar metals.
- B. Provide stainless steel bolts, nuts and washers for piping both above ground and below ground.

3.03 PIPE INSTALLATION

- A. Refer to Section 31 05 00.
- B. Provide concrete thrust blocks or restrained joints at pipe tees and bends as specified on the Drawings.
- C. Unless otherwise specified by local code having jurisdiction, potable water shall maintain 10 foot horizontal and 1 foot vertical clearance from sanitary sewer pipe lines.

3.04 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. UL/FM Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- D. Water-Regulating Valves: Install aboveground between shutoff valves. Install reduced-size lockable valved bypass appropriate for demand. Provide valve suitable for throttling service such as globe or v-port ball valve. Under no circumstances will full-size gate valves be permitted for this service.
- E. Relief Valves: Install aboveground with shutoff valve on inlet.

- F. Detector Check Valves: Install aboveground.

3.05 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Section 33 05 00 – Installation of Buried Pipe for underground warning tapes.
- B. Install solid copper tracer wire with all underground non-metallic piping.

3.06 CLEANING

- A. Refer to Section 33 13 00.

END OF SECTION

**SECTION 33 13 00
DISINFECTION OF WATER UTILITY PIPING SYSTEMS**

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section describes the disinfection of potable water mains, services, appurtenances, and connections by chlorination, in accordance with AWWA C601 and as specified herein. Contractor to provide written copies of all test results from this section

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. 33 14 00 – Hydrostatic Testing of Pressure Pipelines.

1.3 JOB CONDITIONS

- A. Potable water shall be used for chlorination. See Special Provisions section for availability of water.
- B. Requests for use of water from the Owner's waterlines shall be submitted 48 hours in advance.

PART 2 – MATERIALS

2.1 LIQUID CHLORINE SOLUTION

- A. Liquid chlorine solution shall be in accordance with the requirements of ANSI/AWWA B301, and shall be injected with a solution feed chlorinator and a water booster pump.

2.2 CALCIUM HYPOCHLORITE (DRY)

- A. Calcium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300, and shall be dissolved in water to a known concentration in a container and pumped into the pipeline at a measured rate.

2.3 SODIUM HYPOCHLORITE (SOLUTION)

- A. Sodium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300, and shall be diluted in water to desired concentration and pumped into the pipeline at a measured rate.

2.4 SODIUM HYPOCHLORITE TABLETS AND ADHESIVE

- A. Chlorine Content: The tablets shall have an average weight of 0.009 pounds each and shall contain not less than 70% of available chlorine.
- B. Adhesive: Adhesive shall be a type that will not impart taste, odor, or detrimental compounds to the water supply.
- C. Storage: Proper care shall be taken to store hypo-chlorite tablets in tightly closed containers where they will not be accessible to children or unauthorized persons.

2.5 CHLORINE RESIDUAL TEST KIT

- A. For measuring chlorine concentration, a medium range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs shall be used. The kit shall be capable of determining chlorine concentration in the range 1.0 to 25 mg/L. An adequate number of kits shall be maintained by the Contractor in good working order and available for immediate test of residuals at points of sampling.

PART 3 – EXECUTION

3.1 PROCEDURE

- A. Contractor shall notify the Owner Project Manager two (2) working days prior to chlorination of facilities.
- B. All require corporation stops and other plumbing materials necessary for chlorination or flushing of the main shall be installed by and at the expense of the contractor.
- C. All mains shall be thoroughly flushed prior to disinfection.
- D. Every connection served by a main being disinfected shall be tightly shutoff before water is applied to the main. Care shall be taken to expel all air from the main and services during the filling operation.
- E. Water shall be fed slowly into the pipeline with chlorine applied in amounts to produce a dosage of not less than 50 ppm nor more than 100 ppm in all sections of the pipeline and appurtenances.
- F. Treated water shall be retained in the system for a minimum of 24 hours and shall contain a chlorine residual of not less than 25 ppm at the end of the retention period in all sections being disinfected.

3.2 CONCURRENT TESTING

- A. Disinfecting mains and appurtenances, and hydrostatic testing may run concurrently for the required 24-hour test period. In the event there is leakage and repairs are necessary, disinfection of the pipeline shall be repeated as provided in this section.

3.3 REPETITION OF PROCEDURE

- A. If the initial chlorination fails to produce required residuals and bacteriologic tests, chlorination and testing shall be repeated until satisfactory results are obtained.

3.4 FLUSHING

- A. After confirming the chlorine residual, excess chlorine solution shall be flushed from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water.

3.5 BIOLOGICAL TESTING

- A. Samples from the newly disinfected facilities will be collected by the contractor and tested by a state certified laboratory. All facilities must successfully pass bacteriological tests prior to connecting to the existing system.

END OF SECTION

SECTION 33 14 00
HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. These specifications designate the requirements for field pressure and leakage testing of all new and replaced existing water mains intended for the conveyance of potable, fire water and reclaimed water under pressure. The Contractor shall furnish all labor, materials (including water), tools, and equipment necessary to provide and complete field testing as specified. All pipelines shall be tested for water tightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with the applicable requirements of AWWA C 600 except as modified herein.

1.02 SUBMITTALS

- A. Hydrostatic test results shall be submitted for review and approval.

1.03 JOB CONDITIONS

- A. For potable water pipelines, obtain and use only potable water for hydrostatic testing.
- B. Submit request for use of water from waterlines to Owner Project Manager 48 hours in advance.
- C. The testing shall be witnessed by the Owner Project Manager.

PART 2 - PRODUCTS:

2.01 MANUAL AIR-RELEASE VALVES

- A. Provide temporary manual air-release valves for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat equal to the adjacent pipe.

PART 3 - EXECUTION

3.01 TESTING AND DISINFECTION SEQUENCE

- A. Perform required chlorination subsequent to hydrostatic testing, except when pipeline being tested is connected to a potable waterline.
- B. The test shall be made prior to connecting the new line with existing pipe and mains. The test shall further be conducted with valves open, and the open ends of pipes, valves, and fittings suitably closed. Valves shall be operated and checked during to the test period. No leakage shall be allowed when testing across any valves.

3.02 INITIAL PIPELINE FITTING

- A. Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by releasing air manually.

3.03 PRESSURE AND DURATION OF TEST

- A. All pipe shall be tested at a hydrostatic pressure of 120 percent of maximum rated operating pressure of the pipe, but shall be not less than 200 psi.

- B. When the system is pumped to the required test pressure, the pump shall be disconnected and maintain the test pressure for the following duration by restoring it whenever it falls an amount of 10 psi: pipe of 18 inches in diameter and smaller, 4 hours; over 18 inches to 36 inches in diameter, 8 hours; and over 36 inches in diameter, 24 hours.
- C. Temporary or permanent thrust blocks shall be cast-in-place as required prior to tests, and the Contractor shall provide all necessary braces, plugs, thrust blocks, caps, flanges, and other materials to permit proper conduct of the pressure testing. Concrete blocks shall be cast not less than 5 days before the test.
 - 1. All concrete anchor blocks shall be allowed to cure a sufficient time to develop a minimum strength of 2,000 psi before testing, unless otherwise directed by the Owner Project Manager.

3.04 ALLOWABLE LEAKAGE

- A. Permit one to three days for the filled pipeline to soak and to release entrapped air. Apply the test pressure with a positive displacement pump. Provide a snubber or dampener between the pump and the pipeline to reduce instantaneous pressure pulses to 10% of the specified test pressure. Draw from containers in which the volume of water can be readily measured or through a positive displacement meter. The amount of water used to maintain the test pressure during the test period is the leakage. Determine the allowable leakage by the following:

$$L = \frac{N \cdot D \cdot (P)^{1/2}}{7,400}$$

where L is the allowable leakage in gallons per hour,

N is the number of pipe joints in the test section,

D is the inside pipe test diameter in inches,

P is the pipe test pressure (psi), which is defined as the average of the highest and lowest test pressures in the pipe section being tested.

*N does not include any flanged or welded joints.

3.04 REPETITION OF TEST

- A. If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair at no additional cost to the Owner. All visible leakage shall be eliminated.

END OF SECTION

**SECTION 33 30 00
SANITARY SEWER PIPING AND APPURTENANCES**

PART 1 - GENERAL

1.1 SUMMARY

- A. The locations of sewer rehabilitation work are listed and graphically shown in the Drawings. Replacement and construction locations provided in this document are approximate and based on record data that may or may not be accurate. The Contractor shall verify location of the sewer pipes prior to construction. Verification may be conducted by potholing, or surface measurement.

1.2 REFERENCES

- A. Standard Specifications for Public Works Construction (SSPWC) "Greenbook" most current edition, including all supplements thereto issued prior to bid opening date, Exclusive of Part 1.
- B. Standard Plans for Public Works Construction, most current edition.
- C. Caltrans Standard Specifications, most current edition.

1.3 SUBMITTALS

- A. General. The Contractor shall submit samples, drawings, and data for the Engineer's approval, which demonstrate fully that the construction, and the materials and equipment to be furnished will comply with the provisions and intent of these Plans and Specifications. Submittals shall be accompanied by a letter of transmittal and shall be in strict accordance with the provisions of this section. Submit priority of processing when appropriate.
 - 1. Specific items to be covered by the submittals shall include, as a minimum, the following:
 - a. Samples.
 - b. Substitutions. The Contract is based on the materials, equipment, and methods described in the Contract Documents. All substitutions are subject to the Engineer's approval. The Engineer will consider proposals for substitution of materials, equipment, and methods only when full and complete technical data and all other information accompany such proposals as required by the Engineer to evaluate the proposed substitution.
 - c. As-built drawings. The Contractor shall prepare the AS BUILT drawings. The Contractor shall deliver to the Owner one complete set of final AS BUILT hard copy drawings together with a set of AutoCAD drawing files showing completed construction, for records before the Contract will be accepted by the Owner.
- B. Shop Drawings. All shop drawings shall be produced to a scale sufficiently large to show all pertinent features of the item and its method of connection to the work.
- C. Submittals. Completely identify each submittal and resubmittal by showing at least the following information:
 - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - 2. Name of project as it appears in these Specifications and Specifications number.
 - 3. Drawing and Specifications section number other than this section to which the submittal applies.
 - 4. Whether this is an original submittal or resubmittal.
- D. For samples, indicate the source of the sample.

1.4 PRODUCT HANDLING

- A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Damaged pipe will be rejected on site. Contractor shall replace damaged pipe at no additional expense to the Owner.

- B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warpage. Use protective covers where pipe may be damaged by direct sunlight.

1.5 INSPECTION

- A. All materials furnished and work done under this Contract will be subject to rigid inspection. The Contractor shall furnish, without extra charge, the necessary test pieces and samples, including facilities and labor for obtaining them, as requested by the Engineer. The Engineer, or his/her authorized agent or agents, at all times shall have access to all parts of the shop and the works where such materials under his/her inspection is being manufactured or the work performed. Work or material that does not conform to these Specifications, although accepted through oversight, may be rejected at any stage of the work. Whenever the Contractor is permitted or directed to do night work or to vary the period during which work is carried on each day, he/she shall give the Engineer due notice, so that inspection may be provided. Such work shall be done under regulations to be furnished in writing by the Engineer.
- B. There will be no charges for the inspection of overtime work ordered by the Engineer or required by these Specifications.

PART 2 - PRODUCTS

2.1 PIPE

- A. PVC gravity – Pipe shall meet the requirements of ASTM D3034 and have a rating of either SDR 26 or SDR 35 (size of pipe and rating to be provided shall be as shown on Drawings). Pipe shall be in accordance to subsection 207-16 of the Standard Specifications for Public Works Construction. Pipe shall be for sewer mains and shall be colored green.

2.2 JOINTS AND FITTINGS

- A. All fittings including 1/8 bends shall be gasket push-on type.
- B. Elastomeric Gasket Joint: Manufacturer's standard. Integrally formed bell, push-fit, rubber gasketed joint system.
- C. Lubricant: Manufacturer's standard.
- D. Fittings: Size, grade, joint type, and lining to match pipe, and as recommended by the pipe manufacturer.
 - 1. PVC fittings shall meet the requirements of ASTM D3034, SDR 35, and shall have gasketed joints. Manufacturers: GPK Products; Vassiallo; or equal.
- E. Pipe Joints.
 - 1. PVC pipe shall have elastomeric gasket joints in accordance with Subsection 207-17.3.2 of the Standard Specifications. Joints in accordance with ASTM D312.

2.3 COUPLINGS FOR DISSIMILAR PIPES

- A. Transition type couplings shall be factory manufactured to ensure tight fit and smooth flow transition at the joint. Poured concrete collar and similar coupling methods will not be accepted.

PART 3 - EXECUTION

3.1 GENERAL

- A. The contractor shall provide all labor, materials, tools, equipment, and services required for the complete and proper completion of all the work as shown on the drawings and/or outlined in these specifications.
- B. Work shall include items not specifically mentioned herein or noted on plans but necessary to make a complete working installation of all systems shown or described herein.

- C. During construction of sanitary sewer facilities, existing sewage flow shall be maintained and conveyed in a watertight manner downstream of the work area.
- D. All excavation spoils and existing pipelines to be replaced shall be removed from the job site and disposed of at a legal disposal site.
- E. Construct the gravity sewer system, complete with appurtenances, to the lines and grades shown.

3.2 TRENCHING

- A. Refer to Section 31 23 16.

3.3 BEDDING

- A. Refer to Section 31 23 00 and Section 32 11 23.

3.4 INSTALLATION

- A. Inspection: Inspect pipe for defects before lowering into the trench. Defective, damaged, or unsound pipe will be rejected.
- B. The existing sanitary sewer line shall be kept operational until the new line is finished and connected.
- C. Laying: After the trench bottom has been properly prepared for pipe installation as specified in Section 31 23 16, lay pipe upgrade with the spigot ends pointing in the direction of flow. Lay each length true to line and grade, to form smooth joint transitions and to prevent sudden offsets of the flow line.
- D. Cleaning: As work progresses, clear the sewer pipe interior of dirt and other debris by keeping swabs in the pipe and pulling them forward past each completed joint.
- E. Pipe Cutting: Cutting for closure or other reasons shall be done neatly by methods recommended by the manufacturer. Sharp edges shall be smoothed to prevent gasket damage.
- F. Jointing: Clean gaskets and seats of foreign materials prior to joint assembly. Apply lubricant as recommended by the pipe manufacturer.
 1. Push On Joint: Carefully insert the spigot end into the bell to prevent entry of dirt and incorrect entry angle. With suitable fork tool, crowbar, or by hand, make the joint to the insertion depth recommended by the manufacturer. When the selected pipe uses joints not designed for full depth insertion, prevent further closure of previously completed joints by restraining movement of the installed line while making succeeding joints.
 2. Mechanical Joint: Carefully center the spigot in the bell and position the gasket evenly in the seat. Tighten bolts alternately to an even torque, causing the follower gland to expand the gasket uniformly for a tight seal.
 3. Plain End Jointing: Install factory made couplers in accordance with manufacturers' directions. Center the coupling collar over the joint and tighten bolts or bands evenly.

3.5 PRESERVATION, REMOVAL, AND ABANDONMENT

- A. Where a pipe or other facility is shown on the plans but is not to be replaced, the Contractor shall take precautions as necessary to not disturb the existing facilities during the course of construction. The Contractor may elect to remove existing facilities and replace it with new facility at locations where it is not feasible to preserve existing facility.
- B. Where it is shown on the plans that existing sewer pipe or manhole is to be removed, the Contractor shall remove the facility in its entirety and back fill per the typical trench section detail and compacted to achieve minimum densities as shown on the typical trench section.
- C. At locations on the plans where existing pipes are to be abandoned, the Contractor shall neatly cut the pipe to be abandoned, fill with grout, and construct a watertight brick and mortar plug with smooth grout all around.

3.6 BACKFILLING OF SELECT MATERIAL

- A. Refer to Sections 31 20 00 and 31 23 16.

3.7 FINAL PIPE CLEANING

- A. Prior to testing, clean all lines to be tested by high pressure water jet or mechanical means. Remove and dispose of fluidized material as approved.

3.8 TESTING

- A. General: All gravity sewer pipes and service laterals shall be tested for exfiltration and/or infiltration and deflection, as specified. All maintenance holes shall be tested for leakage, as specified. Maintenance holes shall be tested prior to backfill placement, whereas all pipe shall be backfilled prior to testing. All leakage tests of sanitary sewer systems shall be in conformance with SSPWC Section 306-1.4.1. For pressure sewers (force main) tests, the water pressure shall be measured at the lowest point of the pipeline section being tested.
- B. Water Exfiltration Test shall be in conformance with SSPWC Section 306-1.4.2.
- C. Water Infiltration Test shall be in conformance with SSPWC Section 306-1.4.3. Unless otherwise specified, infiltration will be measured by the contractor using measuring devices approved by the engineer.
- D. Air Pressure Test shall be in conformance with SSPWC Section 306-1.4.4.
- E. Water Pressure Test shall be in conformance with SSPWC Section 306-1.4.5.
- F. Deflection Test: All flexible and semi-rigid main line pipe shall be tested in accordance with SSPWC Sections 306-1.2.12 and 306-1.2.13 for deflection, joint displacement, or any other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing.

END OF SECTION

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all storm drains as shown on the Drawings and as specified herein, complete.
 - 1. Drainage grates shall have maximum ½" openings perpendicular to the path of travel per CBC 1133B.7.2.
- B. Work Specified in Other Sections:
 - 1. Section 31 23 16: Trenching, Backfilling, and Compaction.

1.02 RELATED DOCUMENTS

- A. Drawings, Specifications, and provisions of Construction Contract, including General, Special and Supplementary Conditions and other General Requirements.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of the specified materials, quantity and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Allowable Tolerances: The allowable dimensional alignment for gravity sewers shall be as follows:
 - 1. Vertical: + 0.02 feet
 - 2. Horizontal: + 0.50 feet

1.04 SUBMITTALS

- A. Test Reports: Contractor's testing agency will report all results of the tests to Owner's Representative who will approve or disapprove Contractor's work.
- B. The following tests shall be performed by Contractor's testing agency:
 - 1. Closed circuit TV inspection video tape and report, if used.
- C. Shop Drawings and Product Data: The following list includes the required shop drawings and samples that shall be submitted.
 - 1. Storm drain pipe and fittings.
 - 2. Cast iron or ductile iron castings.
 - 3. Manholes and structures.
 - 4. Television inspection, video tapes, if used.
- D. Certificates: Furnish manufacturer's certified analysis or certificate of compliance for all shipments of pipe, cast iron frames, grates and covers, valves and other miscellaneous material.
- E. Record Documents: At closeout, submit Record Drawings of installed and located utility piping and products.

1.05 JOB CONDITIONS

- A. All drains shall be connected to the building service at a point 5 feet outside the building unless otherwise indicated.
- B. Protection of Existing Utilities Structures: Protect the existing utilities shown on the Drawings, or the locations of which are known prior to excavation, from damage during excavation and backfilling of trenches and, if damaged, repair them at Contractor's expense.
- C. Removal of Utilities: All utilities indicated to be removed or abandoned shall be removed or abandoned in accordance with utility purveyors requirements.
- D. The Drawings are diagrammatic but shall be followed as closely as actual construction permits. All deviations from the Drawings required to make work conform to the site conditions, and to Work of others, shall be made only as necessary as approved by the Contractor and Engineer. The Sub-Contractor shall verify all dimensions prior to starting work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Brick: Brick for manholes shall conform to ASTM C 32 Grade SS or SM.
- B. Concrete: All concrete shall be per ASTM C478, air entrained and shall conform to ASTM C94 for ready mixed concrete.
- C. Mortar and Plaster: Mortar and plaster for masonry manholes shall consist of one-part portland cement and two-parts fine sand. Lime may be added to the mortar in the amount of not more than 25% of the volume of cement.
- D. Inlet Covers and Grates: Area drain and atrium drain grates per Brooks Products, Kristar, or NDS Products or equal. Size as shown on Drawings.
- E. Backfill: Granular fill used as backfill shall conform to fill requirements specified in Section 31 23 16, TRENCHING, BACKFILLING, AND COMPACTION.
- F. Reinforcing Steel: Reinforcing steel shall be deformed bars except where otherwise noted on Drawings and conform to ASTM A 615, Grade 40.
- G. Manhole steps shall be not less than 14 inches in width, built into and anchored in the walls and spaced uniformly 12 inches apart. The top step shall be 12 inches max below the top surface and the bottom step shall be 16 inches max above the floor. Steps will not be required unless the depth from cover of manhole or inlet to invert of main sewer exceeds 4 feet.
- H. Storm Drain:
 - 1. Pipe. Use one of the following as shown on the Drawings:
 - a. Reinforced Concrete Pipe (RCP) conforming to ASTM Standard C 76 and Subsection 207-2 of the Standard Specification, unless otherwise specified. Use the size, type, and D-load as shown on the Drawings. Pipe shall be spuntype pipe.
 - b. Polyvinyl Chloride Plastic (PVC) Pipe. PVC Pipe shall meet the requirements of ASTM D3034 and have a rating of either SDR 26 or SDR 35 (size of pipe and rating to be provided shall be as shown on the Drawings). Provide written certification that all PVC pipe meets the specification requirements in accordance with Subsection 207-17.4.1 of the Standard Specifications and as specified in the Section. Manufacturers: J.M. Manufacturing Inc. (Ring-Tite); Vinyltech; Pacific Western; or equal.
 - 2. Pipe Joints.
 - a. RCP joints shall be tongue and groove, mortar type of joint. Provide watertight joints where shown on Drawings.
 - b. PVC pipe shall have elastomeric gasket joints in accordance with Subsection 207-17.3.2 of the Standard Specifications. Joints in accordance with ASTM D312.
 - 3. Pipe Fittings.
 - a. PVC fittings shall meet the requirements of ASTM D3034, SDR 35, and shall have gasketed joints. Manufacturers: GPK Products; Vassiallo; or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. All products specified herein and shown on the Drawings shall be installed per manufacturer's instructions.

3.02 SYSTEM LAYOUT

- A. Layout the system determining proper elevations for all components from the lines and grades shown on the Drawings.

3.03 EXCAVATING, BACKFILLING, AND COMPACTING

- A. Perform excavating, backfilling, and compacting for the pipe and structures in accordance with the provisions of Section 31 23 16 of the Specifications.

3.04 INSTALLATION

A. Pipe:

1. Laying Pipe. Shape the bottom of the trench by hand to give uniform circumferential support to the lower fourth of each pipe. Where applicable, pipe laying shall proceed upgrade with the tongue or spigot ends pointing in the direction of the flow. Each pipe shall be laid true to line and grade indicated on the Drawings and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the low line. As the work progresses, clean the interior of the pipe of all dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, keep a swab or drag in the pipe and pull forward past each joint immediately after the joining has been completed. If the maximum width of the trench at the top of the pipe as specified is exceeded, install such concrete cradling, pipe encasement or other bedding as approved by Owner's Representative to support the added load of the backfill. Keep trenches for all sections of the pipe free from water until the pipe-jointing material has set and the trench has been backfilled. Do not lay pipe when the condition of the trench or the weather is unsuitable for such work. At times when the work is not in progress, keep open ends of pipes and fittings securely closed so that no trench water, earth or tamped backfill, can enter. Encase the pipe in concrete or support it on a concrete cradle as approved.
2. Pipe Joints.
 - a. PVC Pipe. Pulling of joints or beveling pipe ends to achieve curvature will not be permitted.
 - b. Reinforced Concrete Pipe. Install the rubber gaskets, if any, in accordance with the printed recommendations of the joint manufacturer.
3. Connection to Existing Pipe. Make connections to existing pipe using one of the joints described above where possible to do so. Where the end of the existing pipe is broken or a standard joint is otherwise impracticable, install a concrete collar to make the connection.
4. Connection to Existing Manholes. Make pipe connections to existing manholes in such a manner that the finished work will conform to the essential applicable requirements for new manholes, including all necessary concrete work, cutting, and shaping.
5. Wye Branches. Install commercially manufactured wye branches where indicated on the Drawings. Cutting into the pipe for connections will not be permitted except as approved by Owner's Representative.
 - a. Pipe Plugs. Plug all open ends of wye branches with a manufactured stopper installed in accordance with provisions for jointing. Plug open ends of sewer pipe with a manufactured stopper or concrete masonry. Concrete masonry plugs shall have a minimum thickness of 4 inches. Install all plugs so that the open end of the pipe is permanently sealed but can be removed for future extensions without damaging the pipe.

B. Manholes:

1. General. Construct manholes of brick or concrete with cast iron frames and covers, and in accordance with the Drawings, Standard Drawings, and provisions of the specifications. Precast reinforced concrete manholes conforming to ASTM C 478 will be acceptable subject to submission and approval of the Shop Drawings. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Make changes in size and grade of the channels gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be built up with brick and mortar or may be half tile laid in concrete or may be constructed by laying full-section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Any material excavated beneath pipe entering and leaving manholes and inlets shall be replaced with concrete. Such concrete fill shall extend to the center of pipe for a distance of at least 3 feet from face of manhole and inlet and shall terminate at a joint.

2. Jointing and Plastering. Fill mortar joints completely and make them smooth and free from surplus mortar on the inside of the manhole. Plaster brick manholes with half inch of mortar over the entire outside surface of walls. Lay brick radially with every sixth course laid as a stretcher course. When precast concrete manhole sections are used, set each section in a fresh bed of mortar to make a mortar joint with a minimum thickness of 1/8 inch. Point up all joints inside and out.
 3. Frames and Covers. Set the cast iron manhole frame in a bed of mortar and adjust to the elevations shown on the Drawings.
 4. Inspection manholes, branch connections and elbows on large diameter pipe shall be built to conform to details indicated on the Drawings.
- C. Inlets and Junction Boxes: Construct inlets and junction boxes of the materials and to the exact dimensions and grades shown on the Drawings. Finish surfaces smooth and true. Expansion joint filler shall be performed bituminous treated fiberboard conforming to ASTM D 994, Type III.
- D. Pumps:
1. Basin to be cleaned thoroughly, with all water and debris removed prior to installing pumps.
 2. Pumps shall be installed and assembled per manufacturer's instructions.

3.05 FIELD QUALITY CONTROL

- A. Contractor Checking and Inspection:
1. Storm Drains
 - a. General. Work performed and materials furnished and installed, as shown on the Drawings or required by the Specifications, shall be subject to review by the Contractor. Provide Owner's Representative with unrestricted access to the Work during construction to allow him the opportunity to review materials and workmanship.
 - b. The storm drain pipe shall be checked by the Contractor when backfill has reached the top of the pipe. Both internal and external inspections for alignments shall be made at this time. The Sub-Contractor shall correct at his expense, to the Contractors' satisfaction, any section of the line found to be unsatisfactory in material, alignment, grade, or joints.

3.06 ADJUSTMENT AND CLEANING

- A. Pavement Repair:
1. Where necessary to cut pavements, drives, sidewalks or other permanent surfaces, the cuts shall be made with neat lines at least 1 foot wider than the trench. Cut material shall be disposed of by Contractor.
 - a. The surfaces that are cut shall be restored to the condition specified before the cut was made. Keep streets open for use and also keep portions of driveways open for use.
 2. Concrete for repair work shall be as specified in Section 32 13 13. Concrete shall be finished to match surrounding surfaces.

3.07 FINAL ACCEPTANCE

- A. Final acceptance of the project shall be contingent upon the satisfactory completion of backfilling, surface repairs, passage of final tests and furnishing "as-builts" Record Drawings showing any deviations from the Drawings.
- B. The Sub-Contractor shall be liable for any failure of storm drain or sanitary sewer facilities installed by him for a period of one year after the date of final acceptance.

END OF SECTION