SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

PROJECT NUMBER: T1922-01 INSTALL SOLAR ARRAY AND FMS BATTERY STORAGE
CAMP CROWDER NESHO, MO

THE FOLLOWING DESIGN PROFESSIONALS HAVE SIGNED AND SEALED THE ORIGINAL PLANS AND SPECIFICATIONS FOR THIS PROJECT, WHICH ARE ON FILE WITH THE DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION:

ROBERT E. FRED WILSON
REGISTERED PROFESSIONAL ENGINEER
NUMBER E-27189
3/12/2020

KATHLEEN J. HAGEN
REGISTERED PROFESSIONAL ENGINEER
NUMBER E-700059328
3/12/20

CHARLES G. THARP
PROFESSIONAL ENGINEER
NUMBER E-029567

Digitally signed by Charles G. Tharp
Date: 2020.03.12 05:29:22 -05'00'
SECTION 000115 – LIST OF DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section provides a comprehensive list of the drawings that comprise the Bid Documents for this project.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF DRAWINGS

A. The following list of drawings is a part of the Bid Documents:

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Install Solar Array & FMS Battery Storage
Project No. T 1922-01 000115 - 1 Rev. 0/Issued for Construction
END OF SECTION 000115
SECTION 011000 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Access to site.
   4. Coordination with occupants.
   5. Work restrictions.
   7. Miscellaneous provisions.

1.2 PROJECT INFORMATION

A. Project Identification: Install Solar Array & FMS Battery Storage, Camp Crowder, Neosho, MO.

B. Project No. T 1922-01
   1. Project Location: Camp Crowder, Neosho MO.

       PROJECT ADDRESS.
       CAMP CROWDER TRAINING SITE
       890 RAY A. CARVER AVE.
       NEOSHO MO 64850

C. Owner: State of Missouri, Missouri National Guard. Office of Administration, Division of Facilities Management, Design and Construction, Harry S Truman State Office Building, Post Office Box 809, 301 West High Street, Jefferson City, Missouri 65102
   1. Owner's Representative: Jeremy Newton


1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
   1. Installation of Solar Arrays, multiple buildings. Installation of FMS Battery Storage Building at the Camp Crowder Training Site, Neosho MO.
B. Type of Contract.
   1. Project will be constructed under a single prime contract.

1.4 DESIGNER’S ESTIMATE OF CONSTRUCTION COSTS
A. The project designer has estimated a project cost range of $1,275,000 to 1,750,000.

1.5 PHASED CONSTRUCTION
A. The project will be conducted in a single phase.
   1. Contractor may propose and implement alternate phasing if approved by owner in writing.
B. Before commencing Work, submit a copy of Contractor's construction schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.6 ACCESS TO SITE
A. General: Contractor shall have unlimited use of Project site for construction operations. The buildings will be fully accessible for construction work.
   1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
B. Condition of Existing Buildings: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS
A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

   1. Notify Owner not less than two days in advance of proposed utility interruptions.

C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

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

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.
   
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Contract Change.

B. Types of allowances include the following:
   
   1. Weather allowances.

C. Related Sections include the following:
   
   1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Contract Changes for allowances.

1.3 WEATHER ALLOWANCE

A. Included within the completion period for this project are a specified number of “bad weather” days (see Schedule of Allowances).

B. The Contractor’s progress schedule shall clearly indicate the bad weather day allowance as an “activity” or “activities”. In the event weather conditions preclude performance of critical work activities for 50% or more of the Contractor’s scheduled workday, that day shall be declared unavailable for work due to weather (a “bad weather” day) and charged against the above allowance. Critical work activities will be determined by review of the Contractor’s current progress schedule.

C. The Contractor’s Representative and the Construction Representative shall agree monthly on the number of “bad weather” days to be charged against the allowance. This determination will be documented in writing and be signed by the Contractor and the Construction Representatives. If there is a failure to agree on all or part of the “bad weather” days for a particular month, that disagreement shall be noted on this written document and signed by each party’s representative. Failure of the Contractor’s representative to sign the “bad weather” day documentation after it is presented, with or without the notes of disagreement, shall constitute agreement with the “bad weather” day determination contained in that document.

D. There will be no modification to the time of contract performance due solely to the failure to deplete the “bad weather” day allowance.
E. Once this allowance is depleted, a no cost Contract Change time extension will be executed for “bad weather” days, as defined above, encountered during the remainder of the Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

A. Weather Allowance: Included within the completion period for this Project Ten (10) ”bad weather” days.

END OF SECTION 012100
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract Modifications.

B. Related Sections include the following:
   1. Division 1, Section 012100 "Allowances" for procedural requirements for handling and processing Allowances.
   2. Division 0, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
   3. Division 0, Section 007213, Article 4.0 "Changes in the Work" for Contract Change requirements.

1.3 REQUESTS FOR INFORMATION

A. In the event that the Contractor or Subcontractor, at any tier, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation, the Contractor shall submit a “Request for Information” (RFI) in writing to the Designer. A RFI may only be submitted by the Contractor and shall only be submitted on the RFI forms provided by the Owner. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI, the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

B. Responses to RFI shall be issued within ten (10) working days of receipt of the Request from the Contractor unless the Designer determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Designer, the Designer will, within five (5) working days of receipt of the request, notify the Contractor of the anticipated response time. If the Contractor submits a RFI on a time sensitive activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Designer to respond to the request provided that the Designer responds within the ten (10) working days set forth above.

C. Responses from the Designer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a RFI will cause a change to the requirements of the Contract Document, the Contractor shall give written notice to the Designer requesting a Contract Change for the work. Failure to give such written notice within ten (10) working days, shall waive the Contractor’s right to seek additional time or cost under Article 4, “Changes in the Work” of the General Conditions.
1.4 MINOR CHANGES IN THE WORK

A. Designer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Amount or the Contract Time, on “Designer’s Supplemental Instructions” (DSI).

1.5 PROPOSAL REQUESTS

A. The Designer or Owner Representative will issue a detailed description of proposed Changes in the Work that may require adjustment to the Contract Amount or the Contract Time. The proposed Change Description will be issued using the “Request for Proposal” (RFP) form. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by the Designer or Owner Representative are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within ten (10) working days after receipt of Proposal Request, submit a proposal for the cost adjustments to the Contract Amount and the Contract Time necessary to execute the Change. The Contractor shall submit his proposal on the appropriate Contract Change Detailed Breakdown form. Subcontractors may use the appropriate Contract Change Detailed Breakdown form or submit their proposal on their letterhead provided the same level of detail is included. All proposals shall include:
   a. A detailed breakdown of costs per Article 4.1 of the General Conditions.
   b. If requesting additional time per Article 4.2 of the General Conditions, 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.

1.6 CONTRACT CHANGE PROCEDURES

A. On Owner's approval of a Proposal Request, the Designer or Owner Representative will issue a Contract Change for signatures of Owner and Contractor on the “Contract Change” form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REFERENCED FORMS

A. The following forms can be found on our website at https://www.oa.mo.gov/facilities/vendor-links/architectengineering-forms or https://www.oa.mo.gov/facilities/vendor-links/contractor-forms:

1. Request for Information
2. Designer’s Supplemental Instructions
3. Request for Proposal
4. Contract Change
5. Contract Change Detailed Breakdown – SAMPLES
6. Contract Change Detailed Breakdown – General Contractor (GC)
7. Contract Change Detailed Breakdown – Subcontractor (SUB)

END OF SECTION 012600
SECTION 013100 – COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Projects including, but not limited to, the following:
   1. Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Project meetings.

B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific Contractor.

C. Related Sections include the following:
   1. Division 013200, Section "Schedules" for preparing and submitting Contractor's Construction Schedule.
   3. Article 5.4.H of Section 007213 "General Conditions" for coordinating Closeout of the Contract.

1.3 COORDINATION

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, which depend on each other for proper installation, connection, and operation.

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.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's Construction Schedule.
   2. Preparation of the Schedule of Values.
   3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Startup and adjustment of systems.
8. Project Closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

A. Contractor shall provide a detailed Project Construction Schedule detailing the phases of work.

B. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

C. Key Personnel Names: Within fifteen (15) work 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 telephone numbers including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
   1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 PROJECT MEETINGS

A. The Owner’s Construction Representative will schedule a Pre-Construction Meeting prior to beginning of construction. The date, time, and exact place of this meeting will be determined after Contract Award and notification of all interested parties. The Contractor shall arrange to have the Job Superintendent and all prime Subcontractors present at the meeting. During the Pre-Construction Meeting, the construction procedures and information necessary for submitting payment requests will be discussed and materials distributed along with any other pertinent information.
   1. Minutes: Designer will record and distribute meeting minutes.

B. Progress Meetings: The Owner’s Construction Representative will conduct Monthly Progress Meetings as stated in Articles 1.8.B and 1.8.C of Section 007213 “General Conditions”.
   1. Minutes: Designer will record and distribute to Contractor the meeting minutes.

C. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity that requires 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 Designer and Construction Representative 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 Contract Changes
   e. Purchases
   f. Deliveries
   g. Submittals
   h. Possible conflicts
   i. Compatibility problems
   j. Time schedules
   k. Weather limitations
   l. Manufacturer's written recommendations
   m. Warranty requirements
   n. Compatibility of materials
   o. Acceptability of substrates
   p. Temporary facilities and controls
   q. Space and access limitations
   r. Regulations of authorities having jurisdiction
   s. Testing and inspecting requirements
   t. Installation procedures
   u. Coordination with other Work
   v. Required performance results
   w. Protection of adjacent Work
   x. Protection of construction and personnel

3. Contractor shall 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 parties who should have been present.

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.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100
SECTION 013200 – SCHEDULE – BAR CHART

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for a Bar Chart Schedule for the project construction activities, schedule of submittals, and schedule for testing.

PART 2 - PRODUCTS – (Not Applicable)

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURES

A. The Contractor shall submit to the Owner and Engineer, within ten (10) working days following the Notice to Proceed, a Progress Schedule showing the rate of progress the Contractor agrees to maintain and the order in which he proposed to carry out the various phases of Work. No payments shall be made to the Contractor until the Progress Schedule has been approved by the Owner.

B. The Contractor shall submit an updated Schedule for presentation at each Monthly Progress Meeting. The Schedule shall be updated by the Contractor as necessary to reflect the current Schedule and its relationship to the original Schedule. The updated Schedule shall reflect any changes in the logic, sequence, durations, or completion date. Payments to the Contractor shall be suspended if the Progress Schedule is not adequately updated to reflect actual conditions.

C. The Contractor shall submit Progress Schedules to Subcontractors to permit coordinating their Progress Schedules to the general construction Work. The Contractor shall coordinate preparation and processing of Schedules and reports with performance of other construction activities.

3.2 CONSTRUCTION PROGRESS SCHEDULE – BAR CHART SCHEDULE

A. Bar-Chart Schedule: The Contractor shall prepare a comprehensive, fully developed, horizontal bar chart-type Contractor’s Construction Schedule. The Contractor for general construction shall prepare the Construction Schedule for the entire Project. The Schedule shall show the percentage of work to be completed at any time, anticipated monthly payments by Owner, as well as significant dates (such as completion of excavation, concrete foundation work, underground lines, superstructure, rough-ins, enclosure, hanging of fixtures, etc.) which shall serve as check points to determine compliance with the approved Schedule. The Schedule shall also include an activity for the number of “bad” weather days specified in Section 012100 – Allowances.

1. The Contractor shall provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
a. If practical, use the same Schedule of Values breakdown for schedule
time bars.

2. The Contractor shall provide a base activity time bar showing duration for each
construction activity. Each bar is to indicate start and completion dates for the
activity. The Contractor is to place a contrasting bar below each original
schedule activity time for indicating actual progress and planned remaining
duration for the activity.

3. The Contractor shall prepare the Schedule on a minimal number of separate
sheets to readily show the data for the entire construction period.

4. Secure time commitments for performing critical elements of the Work from
parties involved. Coordinate each element on schedule with other construction
activities. Include minor elements involved in the overall sequence of the Work.
Show each activity in proper sequence. Indicate graphically the sequences
necessary for completion of related portions of the Work.

5. Coordinate the Contractor’s Construction Schedule with the Schedule of Values,
list of subcontracts, Submittal Schedule, progress reports, payment requests, and
other required schedules and reports.

6. Indicate the Intent to Award and the Contract Substantial Completion dates on
the schedule.

3.3 SCHEDULE OF SUBMITTALS

A. Prepare the schedule in chronological order. Provide the following information

1. Scheduled date for the first submittal
2. Related Section number
3. Submittal category
4. Name of the Subcontractor
5. Description of the part of the Work covered
6. Scheduled date for resubmittal
7. Scheduled date for the Designer’s final release or approval

B. Distribution: Following the Designer’s response to the initial submittal schedule, print
and distribute copies to the Designer, Owner, subcontractors, and other parties required to
comply with submittal dates indicated.

1. Post copies in the Project meeting room and temporary field office.
2. When revisions are made, distribute to the same parties and post in the same
locations. Delete parties from distribution when they have completed their
assigned part of the Work and are no longer involved in construction activities.

C. Schedule Updating: Revise the schedule after each meeting or other activity where
revisions have been recognized or made. Issue the updated schedule concurrently with
the report of each meeting.

3.4 SCHEDULE OF INSPECTIONS AND TESTS

A. Prepare a schedule of inspections, tests, and similar services required by the Contract
Documents. Submit the schedule with (15) days of the date established for
commencement of the Contract Work. The Contractor is to notify the testing agency at least (5) working days in advance of the required tests unless otherwise specified.

B. Form: This schedule shall be in tabular form and shall include, but not be limited to, the following:

1. Specification Section number
2. Description of the test
3. Identification of applicable standards
4. Identification of test methods
5. Number of tests required
6. Time schedule or time span for tests
7. Entity responsible for performing tests
8. Requirements for taking samples
9. Unique characteristics of each service

C. Distribution: Distribute the schedule to the Owner, Engineer, and each party involved in performance of portions of the Work where inspections and tests are required.

END OF SECTION 013200
SECTION 013300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work including the following:

1. Shop Drawings
2. Product Data
3. Samples
4. Quality Assurance Submittals
5. Construction Photographs
6. Operating and Maintenance Manuals
7. Warranties

B. Administrative Submittals: Refer to General and Supplementary Conditions other applicable Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

1. Construction Progress Schedule including Schedule of Values
2. Performance and Payment Bonds
3. Insurance Certificates
4. Applications for Payment
5. Certified Payroll Reports
6. Partial and Final Receipt of Payment and Release Forms
7. Affidavit – Compliance with Prevailing Wage Law
8. Record Drawings
9. Notifications, Permits, etc.

C. The Contractor is obliged and responsible to check all shop drawings and schedules to assure compliance with contract plans and specifications. The Contractor is responsible for the content of the shop drawings and coordination with other contract work. Shop drawings and schedules shall indicate, in detail, all parts of an Item or Work including erection and setting instructions and integration with the Work of other trades.

D. The Contractor shall at all times make a copy, of all approved submittals, available on site to the Construction Representative.
1.3 SUBMITTAL PROCEDURES

A. The Contractor shall comply with the General and Supplementary Conditions and other applicable sections of the Contract Documents. The Contractor shall submit, with such promptness as to cause no delay in his work or in that of any other contractors, all required submittals indicated in Part 3.1 of this section and elsewhere in the Contract Documents. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
   a. The Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:

1. Date of Submission
2. Name of Project
3. Location
4. Section Number of Specification
5. State Project Number
6. Name of Submitting Contractor
7. Name of Subcontractor
8. Indicate if Item is submitted as specified or as a substitution

1.4 SHOP DRAWINGS

A. Comply with the General Conditions, Article 3.2.

B. The Contractor shall submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

C. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings including the following information:

1. Dimensions
2. Identification of products and materials included by sheet and detail number
3. Compliance with specified standards
4. Notation of coordination requirements
5. Notation of dimensions established by field measurement
6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8½”x11” but no larger than 36”x48”.

1.5 PRODUCT DATA

A. The Contractor shall comply with the General Conditions, Article 3.2.

B. The Contractor shall collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer’s installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information including the following information:
   a. Manufacturer’s printed recommendations
   b. Compliance with Trade Association standards
   c. Compliance with recognized Testing Agency standards
   d. Application of Testing Agency labels and seals
   e. Notation of dimensions verified by field measurement
   f. Notation of coordination requirements

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

1.6 SAMPLES

A. The Contractor shall comply with the General Conditions, Article 3.2.

B. The Contractor shall submit full-size, fully fabricated samples, cured and finished as specified, and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. The Contractor shall mount or display samples in the manner to facilitate review of qualities indicated. Prepare samples to match the Designer’s sample including the following:
   a. Specification Section number and reference
   b. Generic description of the Sample
   c. Sample source
   d. Product name or name of the Manufacturer
   e. Compliance with recognized standards
   f. Availability and delivery time
2. The Contractor shall submit samples for review of size, kind, color, pattern, and texture. Submit samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
   a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
   b. Refer to other Specification Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
   c. Refer to other Sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.
   d. Samples not incorporated into the Work, or otherwise designated as the Owner’s property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.

3. Field samples are full-size examples erected onsite to illustrate finishes, coatings, or finish materials and to establish the Project standard.
   a. The Contractor shall comply with submittal requirements to the fullest extent possible. The Contractor shall process transmittal forms to provide a record of activity.

1.7 QUALITY ASSURANCE DOCUMENTS

A. The Contractor shall comply with the General Conditions, Article 3.2

B. The Contractor shall submit quality control submittals including design data, certifications, manufacturer’s instructions, manufacturer’s field reports, and other quality-control submittals as required under other Sections of the Specifications.

C. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the Manufacturer certifying compliance with specified requirements.
   1. Signature: Certification shall be signed by an officer of the Manufacturer or other individual authorized to contractually bind the Company.

D. Inspection and Test Reports: The Contractor shall submit the required inspection and test reports from independent testing agencies as specified in this Section and in other Sections of the Contract Documents.

E. Construction Photographs: The Contractor shall submit record construction photographs as specified in this Section and in other Sections of the Contract Documents.
   1. The Contractor shall submit two (2) sets of prints, black and white, glossy; 8”x10” size; mounted on 8½”x11” soft card stock with left edge binding margin for 3-hole punch.
   2. The Contractor shall identify each photograph with project name, location, number, date, time, and orientation.
3. The Contractor shall submit progress photographs monthly unless specified otherwise. Photographs shall be taken one (1) week prior to submitting.

4. The Contractor shall take four (4) site photographs from differing directions and a minimum of five (5) interior photographs indicating the relative progress of the Work.

1.8 OPERATING AND MAINTENANCE MANUALS AND WARRANTIES

   A. The Contractor shall submit all required manufacturer’s operating instructions, maintenance/service manuals, and warranties in accordance with the General Conditions, Article 3.5, and Supplementary Conditions along with this and other Sections of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REQUIRED SUBMITTALS

   A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

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<tr>
<th>SECTION</th>
<th>DESCRIPTION</th>
<th>Shop Drawings</th>
<th>Product Data</th>
<th>Sample</th>
<th>Certifications</th>
<th>Manufacturer’s Instructions</th>
<th>Test Report</th>
<th>Inspection Report</th>
<th>Wiring Diagrams</th>
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Install Solar Array & FMS Battery Storage
Project No. T 1922-01

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END OF SECTION 013300

Install Solar Array & FMS Battery Storage
Project No. T 1922-01 013300 - 6 Rev. 0/Issued for Construction
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUBMITTALS
   A. List of required submittals:
      1. Materials Safety Data Sheets for all hazardous materials to be brought onsite.
      2. Schedule of proposed shutdowns, if applicable.
      3. Required fingerprinting for criminal background and warrants check. A list of the names of all employees who will submit fingerprints for a background check and the signed privacy documents identified below for each employee.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ACCESS TO THE SITE
   A. The Contractor shall arrange with the Construction Representative and appropriate facility representatives for the controlled entry of construction personnel, materials and equipment into the work areas.

   B. The Contractor shall establish regular working hours with the Project Manager and the facility. Normal working hours for this facility are 7:00 AM to 5:00 PM, Tuesday - Friday. Working hour changes or overtime are to be reported and approved 48 hours ahead of time. Emergency overtime is to be reported as soon as it is evident that overtime is needed.

   C. The Contractor shall provide the name and phone number of the individual who is in charge on site and who can be contacted in case of an emergency. This individual must furnish names and addresses of all construction personnel prior to starting work.

3.2 HEALTH, TRAFFIC, FIRE AND SAFETY CONTROLS
   A. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during construction. Keep volatile wastes in covered containers. Do not dispose of volatile wastes or oils in storm or sanitary drains.

   B. Keep project neat, orderly, and in a safe condition at all times. Immediately remove all hazardous waste. Do not allow rubbish to accumulate. Provide on-site containers for collection of rubbish and dispose of it at frequent intervals during progress of work.

   C. No burning will be permitted on the grounds.

   D. Conduct operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent facilities.

   E. Do not obstruct streets or walks or use facilities without permission from the facility representative.

   F. No driver shall exceed the facility speed limit. The facility speed limit is 15 M.P.H. unless indicated otherwise.
G. The Contractor shall be responsible and take all necessary precautions to guard against and eliminate possible fire hazards.

H. Store all flammable or hazardous materials in proper container located outside the buildings or offsite, if possible.

I. Provide and maintain in good order, during construction, all fire extinguishers as required by the National Fire Protection Association. In areas of flammable liquids, asphalt, or electrical hazards, extinguishers of the 15-pound carbon dioxide type or 20-pound dry chemical type shall be provided.

J. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times unless written approval is received from the Construction Representative and the appropriate Facility Representative at least (24) hours in advance. The Contractor shall submit a written time schedule for any proposed shutdowns.

K. Conduct operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Do not obstruct streets or walks or use facilities without permission from the Facility.

L. For all hazardous materials brought onsite, Material Safety Data Sheets shall be on site and readily available upon request at least a day before delivery.

M. Intoxicating beverages or narcotics shall not be brought upon the premises nor shall Contractor’s personnel be under the influence of these substances while on the premises.

3.3 DISRUPTION OF UTILITIES

A. The Contractor shall give minimum (72) hours written notice to the Construction Representative and Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.

B. The contractor shall give minimum (72) hours written notice to the Construction Representative and Facility Representative before closing any access drives and shall make temporary access available if possible. Do not obstruct streets, walks, or parking.

3.4 REQUIRED FINGERPRINTING FOR CRIMINAL BACKGROUND AND WARRANTS CHECK

A. All employees of the Contractor are required to submit fingerprints to the Missouri State Highway Patrol to enable the Office of Administration, Division of Facilities Management, Design and Construction (FMDC) to receive state and national criminal background checks on such employees. FMDC will also check with law enforcement to determine if any of the Contractor’s employees has an outstanding warrant for his or her arrest. FMDC reserves the right to prohibit any employee of the Contractor from performing work in or on the premises of any facility owned, operated, or utilized by the State of Missouri for any reason.

B. The Contractor shall ensure all of its employees submit fingerprints to the Missouri State Highway Patrol and pay for the cost of such background checks. The Contractor shall submit to FMDC a list of the names of the Contractor’s employees who will be fingerprinted and a signed Missouri Applicant Fingerprint Privacy Notice, Applicant Privacy Rights and Privacy Act Statement for each employee. All employees of the Contractor approved by FMDC to work at a State facility must obtain a contractor ID badge from FMDC prior to beginning work on-site, unless the Director of FMDC, at the Director’s discretion, waives the requirement for a contractor ID badge. The Contractor and its employees must comply
C. Pursuant to section 43.540, RSMo, FMDC participates in the Missouri Rap Back and National Rap Back programs as of August 28, 2018. This means that the Missouri State Highway Patrol, Central Records Repository, and the Federal Bureau of Investigation will retain the fingerprints submitted by each of the Contractor’s employees, and those fingerprints will be searched against other fingerprints on file, including latent fingerprints. While retained, an employee’s fingerprints may continue to be compared against other fingerprints submitted or retained by the Federal Bureau of Investigation, including latent fingerprints.

D. As part of the Missouri and National Rap Back programs, FMDC will receive notification if a new arrest is reported for an employee whose fingerprints have been submitted for FMDC after August 28, 2018. If the employee is performing work on a State contract at the time of the arrest notification, FMDC will request and receive the employee’s updated criminal history records. If the employee is no longer performing work on a State contract, FMDC will not obtain updated criminal records.

E. Pursuant to section 43.540, RSMo, the Missouri State Highway Patrol will provide the results of the employee’s background check directly to FMDC. FMDC may NOT release the results of a background check to the Contractor or provide the Contractor any information obtained from a background check, either verbally or in writing. FMDC will notify the Contractor only whether an employee is approved to work on State property.

F. Each employee who submits fingerprints to the Missouri State Highway Patrol has a right to obtain a copy of the results of his or her background check. The employee may challenge the accuracy and completeness of the information contained in a background check report and obtain a determination from the Missouri State Highway Patrol and/or the FBI regarding the validity of such challenge prior to FMDC making a final decision about his or her eligibility to perform work under a State contract.

G. The Contractor shall notify FMDC if an employee is terminated or resigns from employment with the Contractor. If the Contractor does not anticipate performing work on a State contract in the future, the Contractor may request that FMDC remove its employees from the Rap Back programs. However, if removed from the Rap Back programs, employees will be required to submit new fingerprints should the contractor be awarded another State contract.

H. Upon award of a Contract, the Contractor should contact FMDC to determine if its employees need to provide a new background check. If a Contractor’s employee has previously submitted a fingerprint background check to FMDC as part of the Missouri and National Rap Back programs, the employee may not need to submit another fingerprint search for a period of three to six years, depending upon the circumstances. The Contractor understands and agrees that FMDC may require more frequent background checks without providing any explanation to the Contractor. The fact that an additional background check is requested by FMDC does not indicate that the employee has a criminal record.

END OF SECTION 013513.28
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY
A. This Section includes requirements for construction facilities and temporary controls including temporary utilities, support facilities, security, and protection.

B. Temporary utilities include, but are not limited to, the following:
1. Water service and distribution
2. Temporary electric power and light
3. Temporary heat
4. Ventilation

C. Support facilities include, but are not limited to, the following:
1. Field offices and storage sheds
2. Dewatering facilities and drains
3. Temporary enclosures
4. Temporary project identification signs and bulletin boards
5. Waste disposal services
6. Construction aids and miscellaneous services and facilities

D. Security and protection facilities include, but are not limited to, to following:
1. Barricades, warning signs, and lights
2. Sidewalk bridge or enclosure fence for the site
3. Environmental protection

1.3 SUBMITTALS
A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within (15) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE
A. Regulations: Comply with industry standards and applicable laws and regulations including, but not limited to, the following:
1. Building code requirements
2. Health and safety regulations
3. Utility company regulations
4. Police, fire department, and rescue squad rules
5. Environmental protection regulations

   1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 “National Electric Code”.

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist onsite.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. If acceptable to the Designer, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

B. Lumber and Plywood:
   1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
   2. For fences and vision barriers, provide minimum 3/9” (9.5mm) thick exterior plywood.
   3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8” (16mm) thick exterior plywood.

C. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of (15) or less. For temporary enclosures, provide translucent, nylon-reinforced laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
D. Open-Mesh Fencing: Provide 0.120” (3mm) thick, galvanized 2” (50mm) chainlink fabric fencing 6’ (2m) high with galvanized barred-wire top strand and galvanized steel pipe posts, 1½” (38mm) ID for line posts and 2½” (64mm) ID for corner posts.

2.2 EQUIPMENT

A. General: Provide new equipment. If acceptable to the Designer, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.

B. Water Hoses: Provide ¾” (19mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100’ (30m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

H. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated re-circulation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each Facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
   1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
   2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
   3. Obtain easements to bring temporary utilities to the site where the Owner’s easements cannot be used for that purpose.
   4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Designer. Neither the Owner nor Designer will accept cost or use charges as a basis of claims for Contract Change.

B. Temporary Water Service: The Owner will provide water for construction purposes from the existing building system. All required temporary extensions shall be provided and removed by the Contractor. Connection points and methods of connection shall be designated and approved by the Construction Representative.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.
   1. Install electric power service underground, except where overhead service must be used.
   2. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125V, AC 20ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Heating: Provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
1. Heating Facilities: Except where the Owner authorizes use of the permanent system, provide vented, self-contained, LP gas or fuel-oil heaters with individual space thermostatic control.

2. Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.

E. Temporary Toilets: Use of the Owner’s existing toilet facilities will be permitted, so long as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designed by the Construction Representative. At substantial completion, restore these facilities to the condition prevalent at the time of initial use. Contractor may install his own temporary toilets if desired.

F. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a health and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
   1. Provide paper towels or similar disposable materials for each facility.
   2. Provide covered waste containers for used material.
   3. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

G. Drinking-Water Facilities: The Owner will provide drinking water facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

H. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.
   1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Field Offices: Contractors Option to Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings.

C. Storage facilities: Contractor to install temporary storage Connex containers on-site as needed - sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service.

D. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.
E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and materials drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely with incombustible wood framing and other materials. Close openings of 25SqFt (2.3SqM) or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Where temporary wood or plywood enclosure exceeds 100SqFt (9.2SqM) in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.

F. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and not temporary facilities.

G. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.

1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.

2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

H. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.

I. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

J. Rodent Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures are regular intervals so the Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Designer.
B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”.

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one (1) extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.

4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

C. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.

D. Enclosure Fence: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.

1. Provide open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth.

E. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1. Storage: Where materials and equipment must be stored and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

F. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
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.

2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Designer requests that it be maintained longer, remove each temporary facility when the need has ended, when 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 the 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 the Contractor’s property. The Owner reserves the right to take possession of project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. 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 the temporary entrances as required by the governing authority.

3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:
   a. Replace significantly worn parts and parts subject to unusual operating conditions.
   b. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION 015000
SECTION 017400 – CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for cleaning during the Project.

B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.
   1. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
   2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator for the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. General
   1. Retain all stored items in an orderly arrangement allowing maximum access, not impending drainage or traffic, and providing the required protection of materials.
   2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
   3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the jobsite.
   4. Provide adequate storage for all items awaiting removal from the jobsite, observing all requirements for fire protection and protection of the ecology.

B. Site
   1. Daily, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
   2. Weekly, inspect all arrangements of materials stored onsite. Re-stack, tidy, or otherwise service all material arrangements.
3. Maintain the site in a neat and orderly condition at all times.

C. Structures

1. Daily, inspect the structures and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.

2. Weekly, sweep all interior spaces clean. “Clean” for the purposes of this paragraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and handheld broom.

3. In preparation for installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.

4. Following the installation of finish floor materials, clean the finish floor daily while work is being performed in the space in which finish materials have been installed. “Clean” for the purposes of this subparagraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Construction Representative, may be injurious to the finish of the finish floor material.

3.2 FINAL CLEANING

A. General: Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer’s instructions.

B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.

1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, litter, and foreign substances.

2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

3. Remove petrochemical spills, stains, and other foreign deposits.

4. Remove tools, construction equipment, machinery, and surplus material from the site.

5. Clean exposed exterior and interior hard-surfac ed 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.

6. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.


8. Vacuum clean carpet and similar soft surfaces removing debris and excess nap. Shampoo, if required.

9. Clean transparent material, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged...
transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

10. Remove labels that are not permanent labels.
11. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
   a. Do not paint over “UL” and similar labels, including mechanical and electrical nameplates.
12. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
13. Clean plumbing fixtures to a sanitary condition free of stains, including stains resulting from water exposure.
14. Clean exposed surfaces of diffusers, registers, and grills.
15. Clean ducts, blowers, and coils if units were operated without filters during construction.
16. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
17. Leave the Project clean and ready for occupancy.

C. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

D. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.

1. Where extra materials of value remain after Final Acceptance by the Owner, they become the Owner’s property.

END OF SECTION 017400
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This 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 Sections include the following:

1. Division 01 Section "Multiple Contract Summary" for coordination of responsibilities for waste management.
2. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.

1.03 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction repair operations.

B. Demolition Waste: Building and site improvement materials and other solid waste resulting from construction repair operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of federal, state, tribal and local authorities having jurisdiction.
B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 DISPOSAL OF WASTE

A. General: Presidential Executive Order 13514 "Federal Leadership in Environmental, Energy, and Economic Performance", 8 October, 2009 requires the diversion of at least 50%, by weight of all construction and demolition materials and debris by the end of fiscal year 2015. Therefore, the contractor shall make all reasonable efforts to recycle and recover Construction and Demolition (C&D) waste from this project. Records shall be maintained to document the quantity of waste generated, the quantity of waste diverted through sale, reuse, or recycling, and the quantity of waste disposed of by landfill or incineration.

1. All records must be provided to the project manager upon project completion.

B. Except for items or materials to be salvaged, recycled, or otherwise reused, 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.

C. Burning: Do not burn waste materials.

D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01 74 19
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. New Cast-In-Place Concrete work is limited to an exterior foundation/grade beam, interior concrete floor slab replacement and solar array foundations. For exterior side walk replacement, refer to specification section 321313 – Concrete Paving.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1.4 QUALITY ASSURANCE

A. 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."

2. Testing Agency Qualifications: The Contractor shall retain the services of An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated. The Contractor shall be required to notify the Owner’s representative a minimum of 48 hours prior to all placement of concrete.
1.5 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1.
   1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or
      chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract
   Documents:
   1. ACI 301.
   2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and
   smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material.
   Provide lumber dressed on at least two edges and one side for tight fit.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening
   reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel
   wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

A. Cementitious Materials:
   2. Fly Ash: ASTM C 618, Class F or C not to exceed 15%

B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
   1. Maximum Coarse-Aggregate Size 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

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.

E. Water: ASTM C 94/C 94M and potable.

2.5 CURING MATERIALS

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

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

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

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.6 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

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

C. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.7 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Normal-Weight Concrete:
1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.8 FABRICATING REINFORCEMENT
A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING
A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
   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.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION
A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
C. Chamfer exterior corners and edges of permanently exterior exposed concrete.

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

3.3 STEEL REINFORCEMENT INSTALLATION
A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3.5 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

3.6 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Cure for not less than seven days.
days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

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

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.7 CONCRETE SURFACE REPAIRS

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

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each concrete mixture placed each day.
2. 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.
3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM 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.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days, three specimens at 28 days and keep one specimen as a hold cylinder to be tested as required at the direction of the Engineer.

a. A compressive-strength test shall be the average compressive strengths from at least three 4 by 8 in. cylinders made from the same sample of concrete and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if every arithmetic 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 Engineer, 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. Concrete paving will be considered defective if it does not pass tests and inspections.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

END OF SECTION 033000
SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Concrete masonry units.
      2. Decorative concrete masonry units.
      3. Steel reinforcing bars.

1.2 DEFINITIONS
   A. CMU(s): Concrete masonry unit(s).
   B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

1.4 INFORMATIONAL SUBMITTALS
   A. Material Certificates: For each type and size of product. For masonry units, include material test reports substantiating compliance with requirements.
   B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
      1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
      2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
1.5 QUALITY ASSURANCE

1.6 FIELD CONDITIONS

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


PART 2 - PRODUCTS

2.1 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 are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

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

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3050 psi.

2. Density Classification: Normal weight.

D. Decorative CMUs: ASTM C90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3050 psi.
2. Density Classification: Normal weight.
3. Pattern and Texture:
   a. Standard pattern, split-face finish.

2.3 STEEL LINTELS
   A. Angles, L Shapes, primed: ASTM A36/A36M.

2.4 MORTAR AND GROUT MATERIALS
   A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   B. Hydrated Lime: ASTM C207, Type S.
   C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
   D. Masonry Cement: ASTM C91/C91M.
   E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
   F. Aggregate for Mortar: ASTM C144.
      1. White-Mortar Aggregates: Natural white sand or crushed white stone.
      2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
   H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
   I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
   J. Water: Potable.

2.5 REINFORCEMENT
   A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

2. Wire Size for Side Rods: 0.148-inch diameter.
4. Spacing of Cross Rods: Not more than 16 inches.
5. Provide in lengths of not less than 10 feet

2.6 TIES AND ANCHORS

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

3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rigid Anchors: Fabricate from steel bars 1-1/2 inch wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA’s "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
4. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
5. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.

B. Flexible Flashing: Use one of the following unless otherwise indicated:"Copper-Laminated Flashing" Subparagraph below is an example only; revise if other laminated products are required.

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.
2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 in.


4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch.

C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MASONRY-CELL FILL

A. Lightweight-Aggregate Fill: ASTM C331/C331M.

2.10 MORTAR AND GROUT MIXES

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

1. Do not use calcium chloride in mortar or grout.
2. For exterior masonry, use masonry cement mortar.
3. For reinforced masonry, use masonry cement mortar.
4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For reinforced masonry, use Type N.
2. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 5 percent of masonry cement by weight.
2. Application: Use pigmented mortar for exposed mortar joints with the following units:
   a. Decorative CMUs.
   b. Pre-faced CMUs.

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 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; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

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

3.5 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
   3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
   4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.7 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.8 FIELD QUALITY CONTROL

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

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

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

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

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at seven days and at 28 days.

3.9 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleened for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.10 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste and legally dispose of off Owner's property.
SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Roof deck for installation over cold formed metal framing.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of deck, accessory, and product indicated.
B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS
A. Welding certificates.
B. Product Certificates: For each type of steel deck.
C. Evaluation reports.
D. Field quality-control reports.

1.5 QUALITY ASSURANCE
A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: Gray top surface with white underside.
   2. Deck Profile: B Deck
   3. Profile Depth: 1.5"
   4. Design Uncoated-Steel Thickness: 24 gauge.

2.3 ACCESSORIES

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

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

G. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

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

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

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

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

G. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

H. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.3 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

END OF SECTION 053100
SECTION 054000 - COLD-FORMED 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. Roof rafter framing.
   2. Ceiling joist framing.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings:
      1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
      2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   C. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing agency.
   B. Welding certificates.
   C. Product Certificates: For each type of code-compliance certification for studs and tracks.
   D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
      1. Steel sheet.
      2. Mechanical fasteners.
      3. Miscellaneous structural clips and accessories.
1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

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

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
   2. Lateral Design: AISI S213.

2.2 COLD-FORMED STEEL FRAMING MATERIALS.

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
   1. Grade: ST33H.
   2. Coating: G60 or equivalent.

B. Steel Sheet for Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 33.
   2. Coating: G60.
2.3 ROOF-RAFTER FRAMING
   A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths and gage as noted on the plans, with stiffened flanges, gage as noted on the plans.

2.4 CEILING JOIST FRAMING
   A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths and gage as noted on the plans, punched or unpunched, with stiffened flanges.

2.5 FRAMING ACCESSORIES
   A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
   B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
      1. Supplementary framing.
      2. Bracing, bridging, and solid blocking.
      3. Web stiffeners.
      4. Anchor clips.
      5. End clips.

2.6 ANCHORS, CLIPS, AND FASTENERS
   A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
   B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
   C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
      1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
   D. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS
   A. Galvanizing Repair Paint: ASTM A780/A780M.
   B. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 FIELD QUALITY CONTROL

A. Testing: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
B. Field and shop welds will be subject to testing and inspecting.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000
SECTION 061600 - 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 and ceiling sheathing.

1.3 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.

1.4 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 SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Type and Thickness: Regular, 1/2 inch thick.
2. Size: 48 by 96 inches.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.
C. 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 less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated.

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

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.

D. Coordinate wall 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.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch (6.4-mm) 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 (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) 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 (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-Fiber blanket insulation.
2. Foil Faced polyisocyanurate board insulation.
3. Composite Polyisocyanurate OSB Roof Insulation.
4. Vapor retarders.
5. Extruded polystyrene foam plastic board foundation insulation.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.
B. Research/evaluation reports.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

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. CertainTeed Corporation.
2. Guardian Building Products, Inc.
5. Owens Corning.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

C. Unfaced, Glass-Fiber Blanket Insulation: 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.

D. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
E. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

F. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

G. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

H. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

2.2 FOIL FACED POLYISO RIGID BOARD WALL INSULATION

A. Non-structural sheathing, glass fiber infused polyisocyanurate foam core laminated between 1.0mil smooth reflective aluminum facers on both sides meeting ASTM C1289- Standard Specifications for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board, Type I, Class 2, capable of being installed exposed to the interior without thermal barrier meeting NFPA 286.

2.3 COMPOSITE POLYISOCYANURATE OSB ROOF INSULATION

A. Rigid roof board insulation for use with standing seam metal roofing.

B. Closed-cell polyiso core insulation bonded to 5/8" OSB board of plywood with fiber-reinforced felt facer on bottom side. ASTM C1289, Type V approved for Class 1 insulated roof deck construction.

2.4 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 10 mils thick, with maximum permeance rating of 0.13 perm.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.5 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD FOUNDATION INSULATION

A. Extruded polystyrene boards in this article are also called "XPS boards."

B. Extruded Polystyrene Board, Type X: ASTM C578, Type X, 15-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

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. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber or Mineral-Wool 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. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. 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.
6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

   a. Exterior Walls: Set units with facing placed toward interior of construction.
   b. Interior Walls: Set units with facing placed toward areas of high humidity.
3.3 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.4 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.

1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

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

END OF SPECIFICATION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes standing-seam metal roof panels.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: 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.
C. Samples: For each type of metal panel indicated.

1.3 INFORMATIONAL SUBMITTALS
A. Product test reports.
B. Warranties: Sample of special warranties.

1.4 CLOSEOUT SUBMITTALS
A. Maintenance data.

1.5 QUALITY ASSURANCE
A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 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. 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. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: 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 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:


C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

F. 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.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically
attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. **Steel Panel Systems:** Unless more stringent requirements are indicated, comply with ASTM E1514.

B. **Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels:** Formed with vertical ribs at panel edges and intermediate stiffening ribs or striations between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. **Metallic-Coated Steel Sheet:** aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
   a. Nominal Thickness: 24 gauge.
   b. Exterior Finish: Two-coat fluoropolymer Color: As selected by Owner from manufacturer's full range.

2. **Clips:** One-piece fixed to accommodate thermal movement.
   a. Material: 0.028-inch minimum nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

3. **Panel Coverage:** 12 inches.
4. **Panel Height:** 1.0 inch.

### 2.3 UNDERLAYMENT MATERIALS

A. **Self-Adhering, High-Temperature Underlayment:** Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.

B. **Felt Underlayment:** ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. **Slip Sheet:** Manufacturer's recommended slip sheet, of type required for application.

### 2.4 MISCELLANEOUS MATERIALS

A. **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.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. 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, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

C. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels.

D. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads.

F. Ridge Vent: Slope to slope metal ridge vent for standing seam metal roofs compatible and matching finish and color of metal roof panels with end caps Basis of design type Hi Perf Metal Era or equivalent.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.

2.5 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and 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 with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

5. Watertight Installation:
   a. 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.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

C. 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 will be permanently watertight and weather resistant.

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.

END OF SECTION 074113.16
SECTION 074213.13 - FORMED 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:
      1. Concealed-fastener, lap-seam exterior panels for walls, and interior panels for walls and ceilings.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: 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.
   C. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS
   A. Product test reports.
   B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS
   A. Maintenance data.

1.6 QUALITY ASSURANCE
   A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
1.7 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. 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. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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, ambient; 180 deg F, material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with narrow reveal joint between panels.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 24 gauge.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Sub-framing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, 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.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

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.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.

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. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. 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.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations.

2.5 FINISHES

A. Panels and Accessories:
   1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
   2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 METAL PANEL INSTALLATION

A. 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 at perimeter of all openings.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
C. Flashing and Trim: Comply with performance requirements, and manufacturer's written installation instructions.

3.3 CLEANING

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.

END OF SECTION 074213.13
SECTION 074213.53 - METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes perforated metal soffit panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: 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.

C. Samples: For each type of metal panel indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 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. 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. 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:

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.

2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush-Profile Metal Soffit Panels Perforated panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.

1. Material: Same material, finish, and color as metal roof panels.
2. Panel Coverage: 12 inches.
3. Panel Height: 1.0 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel 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, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

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. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch thick.
2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.

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. Panels and Accessories:

1. 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. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 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.
1. Soffit Framing: Wire tie or clip furring channels to supports.

3.2 METAL PANEL INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. 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.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

D. 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.

3.3 CLEANING

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.

END OF SECTION 074213.53
SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

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."

2.2 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.
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 (2.49 Pa).
   1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: 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 (2.49 Pa).
   1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
   2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
   3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
   4. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

E. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

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. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. 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.

D. Install fill materials by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories and penetratinig 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.

3.2 FIELD QUALITY CONTROL

A. 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.

END OF SECTION 078413
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes sealants as necessary for installation of HVAC equipment and related penetrations:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
5. Number of samples required.
D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

1.5 QUALITY ASSURANCE

A. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
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.
1.8 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.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.

2.4 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

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.
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. Masonry.

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.

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 C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind 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.

   a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
3.4 FIELD QUALITY CONTROL

1. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer’s field-adhesion hand-pull test criteria.

2. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

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

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Tile control and expansion joints.
   c. Joints between different materials listed above.

2. Joint Sealant: Urethane

1. Joint Locations:

   a. Joints between metal panels.
   b. Perimeter joints between materials listed above and frames of doors, windows, louvers and ducts.

2. Joint Sealant: Non Staining Silicone

C. Joint-Sealant Application: 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 and windows.


END OF SECTION 079200
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 standard steel doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.
1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.2 EXTERIOR STEEL DOORS AND FRAMES

A. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3;

1. Doors and Frames: See Architectural Drawings.

B. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

2.3 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

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E. 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.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.4 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
   1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
      b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/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 BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
   4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
   5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
2.5 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11-2012

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

   a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.

   b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.

3. Floor Anchors: Secure with postinstalled expansion anchors.

   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.

5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
2. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:
1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Insulated service doors.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to the International Building Code, 2006.

B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE 7.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

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.
PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection rated glass as required for type of door.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from metal to match curtain slats and finish.

C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.2 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

2.3 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Provide cylinders standard from manufacturer that accept 7-pin BEST Core.
2. Keys: Contractor to provide blank cores plus 10 blank keys to the Owner.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
2.4 CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

2.5 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 MANUAL DOOR OPERATORS

A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf.

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25 lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.7 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

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. ACME Rolling Doors.
   b. Alpine Overhead Doors, Inc.
   c. AlumaTek, Inc.
   d. C.H.I. Overhead Doors.
   e. City-Gates.
   f. Cookson Company.
   g. Cornell Iron Works, Inc.
   h. Dynamic Closures Corp.
   i. Lawrence Roll-Up Doors, Inc.
   j. Mahon Door Corporation.
   k. McKeon Rolling Steel Door Company, Inc.
   l. Metro Door.
   m. Overhead Door Corporation.
   n. QMI Security Solutions.
   o. Raynor.
   p. Southwestern Steel Rolling Door Co.
B. Operation Cycles: Not less than 50,000.

C. Curtain R-Value: Manufacturers standard insulated slat.

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Flat profile slats of 3-1/4-inch center-to-center height.
   1. Insulated-Slat Interior Facing: Metal.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Hood: Match curtain material and finish.
   1. Shape: Round.

H. Integral Frame, Hood, and Fascia for Counter Door: Stainless steel.
   1. Mounting: Between jambs.

I. Locking Devices: Equip door with locking device assembly.


K. Door Finish:
   1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
   2. Factory Prime Finish: Manufacturer's standard color.
   3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide weathertight fit around entire perimeter.
3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SPECIFICATION 083323
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.

1.2 ACTION SUBMITTALS

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

B. Other Action Submittals:
   1. Door Hardware Schedule: Prepared by an AHC Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
      a. Format: Use same door numbers as in the Contract Documents.
      b. Content: Include the following information:
         1) Identification number, location, hand, fire rating, size, and material of each door and frame.
         2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
         3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
         4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.5 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

PART 2 - PRODUCTS
2.1 SCHEDULED DOOR HARDWARE
A. Provide door hardware for each door as scheduled to comply with requirements in this Section.

2.2 HINGES
A. Hinges: BHMA A156.1.

2.3 CONTINUOUS HINGES
A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

2.4 MECHANICAL LOCKS AND LATCHES
A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
   B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
   C. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

2.5 AUXILIARY LOCKS
A. Bored Auxiliary Locks: BHMA A156.5: Grade 1; with strike that suits frame.
   B. Mortise Auxiliary Locks: BHMA A156.5: Grade 1; with strike that suits frame.
   C. Narrow Stile Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame.
2.6 EXIT DEVICES AND AUXILIARY ITEMS
   A. Exit Devices and Auxiliary Items: BHMA A156.3.

2.7 LOCK CYLINDERS
   A. Lock Cylinders: 7-pin Best Cores; color to match handles. Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
   B. Construction Keys: Provide 10 construction blank keys to the Owner.

2.8 KEYING
   B. Keys: Nickel silver.
      1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
         a. Notation: "DO NOT DUPLICATE."
      2. Quantity: Provide 10 blank keys to the Owner.

2.9 OPERATING TRIM
   A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

2.10 SURFACE CLOSERS
   A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.11 MECHANICAL STOPS AND HOLDERS
   A. Wall- and Floor-Mounted Stops: BHMA A156.16; bronze or aluminum.

2.12 DOOR GASKETING
   A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
2.13 THRESHOLDS
A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.14 METAL PROTECTIVE TRIM UNITS
A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick aluminum; with manufacturer's standard machine or self-tapping screw fasteners.

2.15 AUXILIARY DOOR HARDWARE
A. Auxiliary Hardware: BHMA A156.16.

2.16 FABRICATION
A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:
   a. Machine Screws: For the following:
      1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      2) Strike plates to frames.
      3) Closers to doors and frames.
   b. Steel Through Bolts: For the following unless door blocking is provided:
      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.17 FINISHES
A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   2. Custom Steel Doors and Frames: HMMA 831.

C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
   1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

D. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

E. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

F. Lock Cylinders: Conduct keying meeting to establish keyway layout and install construction cores to secure building and areas during construction period.
   1. Furnish permanent cores Best 6 pin or 7 pin as acceptable to Owner for installation.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Specification 962T "Joint Sealants."

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

J. 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.

END OF SPECIFICATION 087100
SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes fixed, louvers.
B. Related Requirements:
   1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
C. Samples: For each type of metal finish required.
D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS
A. Product Test Reports: Based on tests performed according to AMCA 500-L.
B. Windborne-debris-impact-resistance test reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
1. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft., acting inward or outward.

2.2 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver:
   1. Louver Depth: 4 inches.
   2. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 24 gage.

2.3 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Insect screening.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

2.4 MATERIALS

A. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

B. Fasteners: Use types and sizes to suit unit installation conditions.
   1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
   2. For color-finished louver, use fasteners with heads that match color of louver.

2.5 FABRICATION

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.6 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: As selected by Owner from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.2 ADJUSTING

A. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089119
SPECIFICATION 099100 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following substrates:
   1. Concrete masonry units (CMU): Exterior.
   2. Doors and door frames.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 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 specified in Part 3.
   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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Dry-Fog Coatings: 400 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.
   5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Floor Coatings: 100 g/L.
   9. Shellacs, Clear: 730 g/L.
   10. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings 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."
E. Colors: As selected by Owner from manufacturer's full range.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.
B. Primer, Alkali Resistant, Water Based: MPI #3.
C. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.
D. Primer, Latex, for Interior Wood: MPI #39.
E. Primer Sealer, Alkyd, Interior: MPI #45.
F. Primer, Bonding, Water Based: MPI #17.
G. Primer, Bonding, Solvent Based: MPI #69.

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.
B. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
C. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
D. Primer, Galvanized, Water Based: MPI #134.
E. Primer, Vinyl Wash: MPI #80.
F. Primer, Quick Dry, for Aluminum: MPI #95.

2.6 WATER-BASED PAINTS

A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
B. Latex, Interior, (Gloss Level 2): MPI #44.
C. Latex, Interior, (Gloss Level 3): MPI #52.
D. Latex, Interior, (Gloss Level 4): MPI #43.
E. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees): MPI #114.
G. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.
H. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.
J. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.
L. Latex, Interior, High Performance Architectural, (Gloss Level 3): MPI #139.
N. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.
O. Light Industrial Coating, Interior, Water Based (Gloss Level 3): MPI #151.
P. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5): MPI #153.
Q. Light Industrial Coating, Interior, Water Based, Gloss (Gloss Level 6): MPI #154.

2.7 SOLVENT-BASED PAINTS
A. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.
B. Alkyd, Interior, (Gloss Level 3): MPI #51.
C. Alkyd, Interior, Semi-Gloss (Gloss Level 5): MPI #47.
E. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5): MPI #81.
F. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.

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.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.
   5. Plaster: 12 percent.
C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
D. 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 Manual" applicable to substrates 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.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

B. 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.

3.4 CLEANING AND PROTECTION

A. 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.

B. 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, Traffic Surfaces:

1. Clear Water-Based Sealer System MPI EXT 3.2H:
   c. Topcoat: Sealer, water based, for concrete floors, MPI #99.
3.6 EXTERIOR PAINTING SCHEDULE

A. CMU Substrates

1. Latex System
   c. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.

B. Hollow Metal Doors and Frames:

2. Water-Based Light Industrial Coating System:
   c. Topcoat: Light Industrial Coating, exterior water based MPI#163.

END OF SECTION 099100
SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.


G. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.
2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: **Polished chrome-plated**.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: **Polished chrome-plated**.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors.
M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
Q. Verify final equipment locations for roughing-in.
R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION
A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.
M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 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.

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 plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.
3.7 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500
SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plumbing piping heat tracing for freeze prevention with the following electric heating cables:
   1. Self-regulating, parallel resistance.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   B. Shop Drawings: For electric heating cable.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
   B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   2. Chromalox.
   3. Delta-Therm Corporation.
4. Easy Heat; a division of EGS Electrical Group LLC.
5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
7. Raychem; a brand of Tyco Thermal Controls LLC.
8. Thermon Americas Inc.
9. Trasor Corp.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of parallel No. 16 AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned-copper or Stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.

F. Maximum Operating Temperature (Power On): 150 deg F (65 deg C).

G. Maximum Exposure Temperature (Power Off): 185 deg F (85 deg C).

H. 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.

I. Capacities and Characteristics:

2. Piping Diameter: 1 “.
3. Number of Parallel Cables: 1.
4. Electrical Characteristics for Single-Circuit Connection:
   a. Volts: 120.
   b. Phase: 1.
   c. Hertz: 60.

2.2 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F (minus 1 to plus 10 deg C).
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
2.3  ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.

PART 3 - EXECUTION

3.1  APPLICATIONS

A. Install the following types of electric heating cable for the applications described:

3.2  INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables.
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3  FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
2. Test cables for electrical continuity and insulation integrity before energizing.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533
SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes insulating the following plumbing piping services:
   1. Domestic hot and cold-water piping.
   2. Domestic recirculating hot-water piping.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE
A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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 agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   2. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
   3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.


E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: 60 percent by volume and 66 percent by weight.
2.4 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches (50 mm).
   2. Thickness: 6 mils (0.15 mm).
   3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

2.8 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 4 inches (100 mm) o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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 (100 mm) 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.

3.3 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 (50 mm) 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 (50 mm).
   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.

   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for
above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
   4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Install PVC jackets with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected 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.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot and Recirculated Hot Water: Insulation shall be one of the following:
   1. Flexible Elastomeric: 1 inch (25 mm) thick.
   2. Polyolefin: 1 inch (25 mm) thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Cold and Hot Water Piping: Insulation shall be one of the following:
   1. Cellular Glass: 2 inches (50 mm) thick.
   2. Flexible Elastomeric: 2 inches (50 mm) thick.
   3. Polyolefin: 2 inches (50 mm) thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. None.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. PVC: 20 mils (0.5 mm) thick.
SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.2 ACTION SUBMITTALS
A. Product Data: For transition fittings and dielectric fittings.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS
A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

2.2 COPPER TUBE AND FITTINGS
A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.
B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
E. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS
A. Solder Filler Metals: ASTM B 32, lead-free alloys.
B. Flux: ASTM B 813, water flushable.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   2. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).

C. Dielectric Nipples:
   2. Electroplated steel nipple complying with ASTM F 1545.
   3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
   4. End Connections: Male threaded or grooved.
   5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction
loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping to permit valve servicing.

H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

L. Install sleeves for piping penetrations of walls, ceilings, and floors.

M. Install sleeve seals for piping penetrations of concrete walls and slabs.

N. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.6 HANGER AND SUPPORT INSTALLATION

A. Hangers and Supports for Plumbing Piping and Equipment.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
E. Install supports for vertical copper tubing every 10 feet (3 m).

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
4. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if biological examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C); cast- or wrought-copper, solder-joint fittings; and brazed/soldered joints.

END OF SECTION 221116
SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

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


PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 CPVC PIPE AND FITTINGS

A. Solid-Wall CPVC Pipe: ASTM D D-441.

B. CPVC Socket Fittings: ASTM D 1784.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Unshielded, Nonpressure Transition Couplings:
      b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      c. Sleeve Materials:
         1) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   4. Shielded, Nonpressure Transition Couplings:
      b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
   1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. Plumbing Specialties:
   1. Install cleanouts at grade.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. Install sleeves for piping penetrations of walls, ceilings, and floors.

N. Install sleeve seals for piping penetrations of concrete walls and slabs.

O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Plastic, Nonpressure-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 2855 and ASTM D 2665 Appendixes.
3.4 HANGER AND SUPPORT INSTALLATION

A. Hangers and Supports;
   1. Install stainless-steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
   2. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Install individual, straight, horizontal piping runs:
      a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
   5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

F. Install supports for vertical CPVC piping every 48 inches (1200 mm).

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

D. 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.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.
3.7 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed CPVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.8 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be the following:
   1. Solid-wall CPVC pipe, CPVC socket fittings, and solvent-cemented joints.

B. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be the following:
   1. Solid-wall CPVC pipe, CPVC socket fittings, and solvent-cemented joints.

C. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be the following:
   1. Solid wall Cellular-core CPVC pipe, CPVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316
SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Emergency showers, Eyewash Combination Units.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Diagram power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.4 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
   C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS
   A. Standard, Plumbed Emergency Shower with Eyewash Combination Units.
      1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
         a. Haws Corporation
         b. Acorn Safety; a division of Acorn Engineering Company
         c. Bradley Corporation
         d. Encon Safety Products
         e. Guardian Equipment Co
         f. Sellstrom Manufacturing Company
g. Speakman Company.

h. WaterSaver Faucet Co.

2. Piping:
   a. Material: Hot dipped galvanized steel pipe and fittings with powder coated cast iron floor flange, coated with green epoxy paint.
   c. Unit Drain: Outlet at back or side near bottom.

3. Shower:
   a. Capacity: Not less than 20 gpm (76 L/min.) for at least 15 minutes.
   c. Control-Valve Actuator: Pull rod.
   d. Shower Head: 8-inch- (200-mm-) minimum diameter, ABS.
   e. Mounting: Pedestal.

4. Eyewash Unit:
   a. Capacity: Not less than 3.0 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1/2 (DN 15) with flow regulator and stay-open control valve.
   d. Spray-Head Assembly: Two receptor-mounted spray heads.
   e. Receptor: By Manufacturer.
   f. Mounting: Attached shower pedestal.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:
   1. Description: Factory-fabricated equipment with thermostatic mixing valve.
      a. Thermostatic Mixing Valve: Designed to provide 85 deg F (29 deg C) tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
      b. Supply Connections: For hot and cold water.

2.3 EMERGENCY ALARM SYSTEM

A. Emergency Alarm System:
   1. Description: Provide Optional Factory supplied equipment.
      a. 120 Volt emergency alarm and light system. Buzzer and flashing light are activated by 1-1/4 double pole, double through flow switch.
2.4 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation.
   1. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals.

F. Install thermometers in supply and outlet piping connections to water-tempering equipment.

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system.

H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations.

3.2 CONNECTIONS

A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

B. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping.

C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.
3.3 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment.

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Equipment installation requirements common to equipment sections.
   2. Supports and anchorages.

1.2 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, crawlspace, 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.

1.3 QUALITY ASSURANCE
A. 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.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
A. Metal Labels for Equipment:
   1. Material and Thickness: Stainless steel, 0.025-inch (0.64-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

PART 3 - EXECUTION

3.1 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.

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.3 EQUIPMENT LABEL INSTALLATION

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

B. Install or permanently fasten labels on each major item of mechanical equipment.

C. Locate equipment labels where accessible and visible.

END OF SECTION 230500
SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with 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.

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.


F. Bearings: Manufacturers standard or Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.
B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513
SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: For each product.
   1. Backward-inclined centrifugal fans.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance: Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

B. Capacities and Characteristics: See Mechanical Schedule on Drawings.
   1. Total Airflow: 300 cfm.
   2. External Static Pressure: 0.125 Insert inches wg.
3. Housing Material: Aluminum.
4. Special Housing Coating: Epoxy.
5. Drive Type: Direct.
6. Motor:
   a. Electrical Characteristics:
      1) Motor Size: 1/25 HP.
      2) Volts: 120.
      3) Phase: Single.
      4) Hertz: 60.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Basis-of-Design Product: Provide Loren Cook Model ACWD 100W100DL or approved equal by one of the following:

2. Aerovent, a Twin City Fan company.
3. Central Blower Company.
5. Cincinnati Fan.
6. CML Northern Blower Inc.
7. Howden Buffalo Inc.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, 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. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:
1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:
   1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

G. Accessories:
   4. Backdraft Damper.
   5. Birdscreen
   6. Programmable Fan Controller.
   8. Exterior Wall Alarm light to indicate if fan is not in operation when commanded on.

2.3 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.

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. Unit Support: Install centrifugal fans level on exterior wall. Coordinate wall penetrations and flashing with wall construction.

E. Install units with clearances for service and maintenance.
3.2 FIELD QUALITY CONTROL

A. 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 damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Remove and replace malfunctioning units and retest as specified above.
8. Confirm flow switch and alarm function.

END OF SECTION 233416
SECTION 238239.16 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes propeller unit heaters with hot-water coils.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
   B. Shop Drawings:
      1. Include plans, elevations, sections, and 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 details of anchorages and attachments to structure and to supported equipment.
      4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.

1.3 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Basis-of-Design Product: Subject to compliance with requirements, provide Trane Model UHRA – 05 or comparable product by one of the following:
      1. Airtherm; a Mestek company.
      2. Engineered Air.
      4. Rosemex Products.
      5. Ruffneck Heaters; a division of Lexa Corporation.
2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

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 PERFORMANCE REQUIREMENTS

A. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

A. Finish: Manufacturer's standard corrosion resistant construction, factory-assembled and -tested propeller unit heaters before shipping.

B. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Control Devices:

1. Unit-mounted, fan-speed switch.
2. Unit-mounted thermostat.

2.7 CAPACITIES AND CHARACTERISTICS

A. Heating Capacity:

1. Heat Output: Electric 5 KW.

B. Electrical Characteristics for Single-Point Connection:

2. Phase: 1.
3. Hertz: 60.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

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

3.2 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers.

3.3 CONNECTIONS

A. Comply with safety requirements in UL 1995.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

END OF SECTION 238239.16
SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves for raceways and cables.
   2. Sleeve seals.
   4. Common electrical installation requirements.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500
SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 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.
   3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

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

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES
A. Copper Conductors: Comply with NEMA WC 70.
B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES
A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC.

C. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. 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. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. 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.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

C. Cut sleeves to length for mounting flush with both wall surfaces.

D. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

E. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.

F. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
G. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

H. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

I. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

J. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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.


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 260519
SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS
A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller.

B. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Receptacle circuits.
   4. Three-phase motor and appliance branch circuits.
   5. Flexible raceway runs.
   6. Armored and metal-clad cable runs.

B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526
SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 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.
   7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. 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.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel or aluminum.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
I. 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: Setscrew or compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. 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.

B. ENT: Comply with NEMA TC 13 and UL 1653.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Continuous HDPE: Comply with UL 651B.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. 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.

B. 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.
2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. 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.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. 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.

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 Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

D. Tele-Power Poles:
   1. Material: Galvanized steel with ivory baked-enamel finish.
   2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Metal Floor Boxes:
   1. Material: Cast metal or sheet metal.
   2. Type: Semi-adjustable.
   3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.
   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. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   3. Interior Panels: Steel, all sides finished with manufacturer's standard enamel.

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

2.7 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. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC.".
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or fiberglass.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC.".
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
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: EMT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
a. Loading docks.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT or RNC, Type EPC-40-PVC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel or nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. 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 setscrew or compression, steel cast-metal fittings. Comply with NEMA FB 2.10.
   4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with 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 (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Arrange stub-ups so curved portions of bends are not visible above finished slab.

D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
E. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

F. Support conduit within 12 inches (300 mm) of enclosures to which attached.

G. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

H. 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.

I. 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.

J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. 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 (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

N. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) 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.
O. 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.

P. 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.

Q. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC 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.

R. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

S. 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.
T. 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 the box and cover plate or the supported equipment and box.

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

V. Locate boxes so that cover or plate will not span different building finishes.

W. 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.

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

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

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

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

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

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."
3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 3’ below grade at Project site.

E. 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.

3.6 FIRESTOPPING

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

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Identification of power and control cables.
   2. Identification for conductors.
   3. Equipment identification labels.
   5. Warning labels and signs.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.


D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.
2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
   1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
   1. Comply with ANSI Z535.1 through ANSI Z535.5.
   2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
   3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I:
   1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   2. Thickness: 4 mils (0.1 mm).
   3. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
   4. 3-Inch (75-mm) Tensile According to ASTM D 882: 30 lbf (133.4 N), and 2500 psi (17.2 MPa).

2.7 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot (10-m) maximum intervals.

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553
SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes “Bi-Directional” electricity metering, work to accommodate utility company “Bi-Directional” revenue meters used to manage the electrical power system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electricity-metering equipment.

1. PRODUCT DATA

1. Include elevation views of front panels of control and indicating devices and control stations.

2. Include diagrams for power, signal, and control wiring.

3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.

4. Include series-combination rating data for modular meter centers with main disconnect device.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that meters are compatible with connected monitoring and control devices and systems specified.

B. Field quality-control reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.
1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
2. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.7 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and utility-furnished components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

A. Install metering accessories furnished by the utility company, complying with its requirements.

B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.

1. Data Transmission: Transmit pulse data over control-circuit conductors, classified as Class 1 per NFPA 70, Article 725. Retain and revise remaining paragraphs to reflect utility company's requirements for equipment to be provided by Contractor.

C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

D. Meter Sockets:

1. Comply with requirements of electrical-power utility company.

E. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs or disconnect device, wireways, meter socket modules, and feeder circuit breakers arranged in adjacent vertical sections complete with interconnecting buses.

1. Comply with requirements of utility company for meter center.
a. Comply with UL 67.

2. Housing: NEMA 250, Type 3R or Type 4X enclosure.

3. Meter Socket Rating: Coordinated with connected feeder circuit rating.

4. Minimum Short-Circuit Rating: 22,000A symmetrical at rated voltage.

5. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.

6. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers and having an adjustable magnetic trip setting for circuit-breaker frame sizes of 250A and larger. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Circuit breakers shall be operable from outside the enclosure to disconnect the unit. Configure cover so it can be opened only when the disconnect switch is open.

7. Main Disconnect Device: Fusible switch, UL 98 Type GD, series-combination rated by fuse manufacturer to protect downstream feeder and branch circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Switch shall be operable from outside the enclosure to disconnect the unit. Configure cover so that it can be opened only when the disconnect switch is open.

8. Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect downstream circuit breakers and to house load centers and panelboards that have 10,000A interrupting capacity.

   a. Identification: Complying with requirements in Section 260553 "Identification for Electrical Systems."

   b. Physical Protection: Tamper resistant, with hasp for padlock.


10. Surge Protection at Main Terminal Box: Factory installed, integrally mounted, UL 1449 Type 1. Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

F. Arc-Flash Warning Labels:

1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 260573.19 "Arc-Flash Hazard Analysis." Apply a properly sized self-adhesive label at each work location included in the analysis.

2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a properly sized self-adhesive label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

   a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

      1) Location designation.
      2) Nominal voltage.
      3) Flash protection boundary.
      4) Hazard risk category.
5) Incident energy.
6) Working distance.
7) Engineering report number, revision number, and issue date.

2.3 ELECTRICITY METERS

A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.

B. Standard: Comply with ANSI C12.1 and ANSI C12.20, 0.2 accuracy class.

1. Ambient Temperature: Minus 22 deg F to plus 158 deg F (Minus 30 deg C to plus 70 deg C).
2. Humidity: Zero to 95 percent, noncondensing.
3. Capacities and Characteristics:
   a. Circuit: 120/240-V ac, 100 A.
   b. Measure: kWh, onboard LED display.
   c. Remote-Reading Options: None.

C. General Requirements for Meters:

1. Meters Certification: Certified by Liberty Utilities as complying with 4 CCR 4027, Article 2.2.
2. Certify that meters comply with ANSI C12.20 requirements by a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The laboratory shall use test equipment that is certified annually and is traceable to NIST standards.
3. Enclosure: Supplied by meter manufacturer, NEMA 250, Type 3R or Type 4X minimum, with provisions for locking or sealing.
4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
5. Onboard Nonvolatile Data Storage: kWh, until reset.
6. Sensors: Current-sensing type, supplied by electronic meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
   a. Type: Solid core, complying with recommendation of meter manufacturer.

D. kWh Meter: Electronic single-phase and three-phase meters, measuring electricity use.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kWh and current kilowatt load. “Bi-directional”, indicating whether customer is using energy from the utility, or generating excess power being transferred to the utility. Retain accumulated kWh in a nonvolatile memory, until reset.
3. Display: Digital electromechanical counter, indicating accumulative kWh. Indicate both energy used, and energy sent to utility.
E. KY and KYZ Pulse Totalizer:

1. Pulse Totalizer: An instrument for demand and billing applications where one or more utility revenue meters stream KY or KYZ energy pulses. The instrument shall totalize kWh accumulated over the user-selected period and shall log the maximum and minimum kWhd for that period. Record each period with a date/time stamp. Time period shall be user selected from one to 60 minutes.

   a. Pulse Input: One, individually programmable, KYZ Form C (three-wire) contact pulse channels. Pulse interval, pulse rate, and minimum pulse width shall be field adjustable, set for the pulse stream provided by the utility revenue meter.

   b. Data Totalizing Capacity of Each Channel: Not less than 149 days at 15-minute intervals.


   d. Clock: Line frequency.

F. Remote Reading Options: Coordinate with Utility Company for specific requirements.

1. Pulse Output: KY or KYZ, complete with optical sensor and interface devices.
4. USB interface.
5. TCP/IP adapter.

G. Current-Transformer Cabinet: Size and configuration as recommended by metering equipment manufacturer for use with indicated connected feeder and sensors.

H. Data Transmission Cable: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to switchboard installation requirements in NECA 400.

D. Install arc-flash labels as required by NFPA 70.

E. Wiring Method:

1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Install unshielded, twisted-pair cable for control and signal transmission conductors.
3. Minimum conduit size shall be 1/2 inch (13 mm).
F. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 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. Equipment and Software Setup:
   a. Set meter date and time clock.
   b. Test, calibrate, and connect pulse metering system.
   c. Set and verify billing demand interval for demand meters.
   d. Report settings and calibration results.
   e. Set up reporting and billing software, insert billing location names and initial constant values and variable needed for billing computations.

2. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.

3. Turn off circuits supplied by metered feeder and secure them in off condition.

4. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

6. Generate test report and billing for each tenant or activity from the meter reading tests.

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

E. Prepare test and inspection reports.

END OF SECTION 262713
SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).

1.2 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

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.

C. Field quality-control reports.
D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70.
PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. 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.

B. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   4. Lugs: Suitable for number, size, and conductor material.
   5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. 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.

B. 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. Lugs: Suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.


C. 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.
D. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

E. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: 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. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.2 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.
3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. 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.

END OF SECTION 262816
SECTION 263100 - PHOTOVOLTAIC COLLECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. PV systems description.
   2. Manufactured PV units.
   3. PV module framing.
   4. PV array construction.
   5. Inverters.
   7. Mounting structures.
   8. Combiner Boxes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For PV modules.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies.
   3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five (5) years from date of Substantial Completion.
B. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.

1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:

   a. Specified minimum power output to 80 percent or more, for a period of 25 years.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

   A. Silfab 72 Cell Monocrystalline PV modules SLG-M 380 Wp or approved equal by Sunpower, SolarTech Universal, Mission Solar or other US Manufacturer.

2.2 PERFORMANCE REQUIREMENTS

   A. Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.

2.3 PV CAPACITIES AND CHARACTERISTICS

   A. Minimum Electrical Characteristics: See Electrical one-line diagrams.

   4. Rated Short-Circuit Current (Isc): 0.98.

   B. Additional Electrical Characteristics:

   3. Temperature Cycling Range: -40 to +85 deg C.
   4. Hailstone Impact Withstand: 25 (mm) diameter at 83 (km/h) wind velocity.

   C. Normal Operating Temperature Characteristics (NOTC):

   1. Temperature at Nominal Operating Cell Temperature: 45 deg C.
   3. Temperature Coefficient (NOTC Open-Circuit Voltage): 44.8.
2.4 PV SYSTEMS DESCRIPTION

A. Interactive PV System: See electrical one line diagrams and electrical plan drawings. Collectors connected in series and in parallel to the electrical utility; and capable of providing power for Project and supplying power to a distributed network.

1. System Components:
   a. PV modules.
   b. Array frame.
   c. Utility-interactive inverter.
   d. Overcurrent protection, disconnect, and rapid shutdown devices.
   e. Mounting structure.
   f. Utility meter.

2.5 MANUFACTURED PV UNITS

A. Cell Materials: Monocrystalline.
   1. c-Si.
   2. Gallium arsenide (GaAs).

B. Module Construction: Per Manufacturer.
   1. Nominal Size: (994 mm) wide by (1992 mm) long.
   2. Weight: 23.5 kg.

C. Front Panel: Fully tempered glass.

D. Backing Material: Multilayer polyester-based.

E. Junction Box:
   1. Fully potted, vandal resistant.
   2. Flammability Test: UL 1703.

F. Output Cabling:
   1. Quick, multiconnect, polarized connectors.
   2. Two-Conductor Harness: No traditional return wire is needed from the end of a row back to the source combiner.

2.6 PV MODULE FRAMING

A. PV laminates mounted in anodized extruded-aluminum frames.
   1. Entire assembly UL listed for electrical and fire safety, according to UL 1703, and complying with IEC 61215.
   2. Frame strength exceeding requirements of certifying agencies in subparagraph above.
a. Alloy and temper recommended by framing manufacturer for strength, corrosion resistance, and application of required finish.
b. Color: As indicated by manufacturer's designations.

2.7 PV ARRAY CONSTRUCTION

A. Framing: See Electrical Plan and Detail drawings.
   1. Material: Extruded aluminum, Galvanized steel, or Coated steel.
   2. Maximum System Weight: Less than 4 lb/sq. ft. (19.53 kg/sq. m).

2.8 INVERTERS. See Electrical one-line diagrams. Provide Inverters by ABB (single phase systems) or Fronius (three phase systems) or approved equal by SMA, SolarEdge, SolaX Power.

A. Inverter Type: Central.
B. Control Type: Maximum power point tracker control.
C. Inverter Electrical Characteristics: See Electrical One-line diagrams.
D. Operating Conditions:
   1. Operating Ambient Temperatures: Minus 4 to plus 122 deg F (20 to plus 50 deg C).
   2. Storage Temperature: Minus 40 to plus 122 deg F (minus 40 to plus 50 deg C).
   3. Relative Humidity: Zero to 95 percent, noncondensing.
E. Enclosure:
   1. NEMA 250, Type 3R or Type 4X.
   2. Enclosure Material: Per manufacturer.
   3. Protective Functions:
      a. AC over/undervoltage.
      b. AC over/underfrequency.
      c. Ground overcurrent.
      d. Overtemperature.
      e. AC and dc overcurrent.
      f. DC overvoltage.
   4. Standard LCD, four lines, 20 characters, with user display and on/off toggle switch.
F. Disconnects: Rated for system voltage and conductor.
G. Regulatory Approvals:
   1. IEEE 1547.1.
2. IEEE 1547.3.
3. UL 1741.

2.9 SYSTEM OVERCURRENT PROTECTION
A. Fuses: See Electrical one line diagrams.
B. Circuit Breakers: See Electrical one line diagrams.

2.10 MOUNTING STRUCTURES
A. Ground mount on pad or Pole Mount - Side.

2.11 PHOTOSOLTAIC ARRAY COMBINER BOXES.
A. Shall be listed to UL 1741.
B. Shall include internal overcurrent protection devices with dead front.
C. Shall be contained in non-conductive NEMA Type 4X enclosure.
D. Where applicable, combiner box shall be a disconnecting combiner box.

2.12 GROUNDING
A. All applicable components of the solar energy electrical power generating system must be grounded per latest NEC requirements.
B. DC Ground-Fault protection: Shall be listed per UL 1703

2.13 MONITORING AND CONTROLS.
A. Contractor shall provide a complete Wireless Monitoring and controls network.
B. The Solar Inverters shall be provided with manufacturer’s stand wireless access capability or with additional equipment to communicate wirelessly.
C. Contractor shall provide wireless repeaters at each solar array that shall be encrypted, and password protected.
D. Contractor shall provide Cellular Hotspots, encrypted and password protected that shall upload system monitoring information and allow remote communication and control of the inverters. A minimum of three hot spots shall be required. The number of hot spots shall be as determined by the installation contractor; however, the minimum shall be one for the main post area, one for the range area, and one for building 201. Contract shall coordinate with State Project Manager for the appropriate cellular service provider for the installation.
E. A Controls/Monitoring Station shall be set up at the Post Headquarters Building 890. The contractor shall install the web monitoring software and controls on an existing computer as designated by the State Project Manager.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Examine modules and array frame before installation. Reject modules and arrays that show shipping damage, are wet, are moisture damaged, or are mold damaged.

C. Coordinate layout and installation of PV panels with ground support assembly and other construction.

D. Support PV panel assemblies independent of supports for other elements. Support assembly to prevent twisting from eccentric loading.

E. Install PV inverters and system control in locations indicated on Drawings.

F. Install weather seal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 079200 "Joint Sealants" for materials and application.

G. Wiring Method: Install cables in raceways.

H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 CONNECTIONS

A. Coordinate installation of utility-interactive meter with utility.

B. Make splices, terminations, and taps that are compatible with conductor material.

END OF SECTION 263100
SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:
   1. Strip light.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Manufacturers’ Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
B. Product Certificates: For each type of luminaire.
C. Product test reports.
D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
B. Provide luminaires from a single manufacturer for each luminaire type.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C)].
   B. Altitude: Sea level to 1000 feet (300 m)].

2.2 LUMINAIRE REQUIREMENTS
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
      1. Label shall include the following lamp characteristics:
         a. "USE ONLY" and include specific lamp type.
         b. Lamp diameter, shape, size, wattage, and coating.
         c. CCT and CRI.

2.3 STRIP LIGHT See Drawing E-117.
   A. Nominal Operating Voltage: 120 V ac.
   B. Lamp:
      1. Minimum 750 lm.
      2. Minimum allowable efficacy of 75 lm/W.
      3. CRI of minimum 65. CCT of 3500 K.
      4. Rated lamp life of 35,000 hours to L70.
      5. Internal driver.
      6. User-Replaceable Lamps:
         a. Bulb shape complying with ANSI C78.79.
         b. Lamp base complying with ANSI C81.61 or IEC 60061-1.
   C. Housings:
      1. Manufacturer’s Stanadard housing and heat sink.
      3. With integral mounting provisions.
D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping of luminaire without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:
   1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

F. Standards:
   1. ENERGY STAR certified.
   2. RoHS compliant.
   3. UL Listing: Listed for damp location.

2.4 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Steel:
   1. ASTM A36/A36M for carbon structural steel.
   2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:
   1. Manufacturer's standard grade.
   2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
B. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119
SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exit signs.
   2. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
D. Fixture: See "Luminaire" Paragraph.
E. Lumen: Measured output of lamp and luminaire, or both.
F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.
B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXIT SIGNS

A. Internally Lighted Signs:
   1. Operating at nominal voltage of 120 V ac.
   2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
   3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.2 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

   1. Smooth operating, free of light leakage under operating conditions.
   2. Designed to permit relamping without use of tools.

C. Diffusers and Globes:

   1. Clear, UV-stabilized acrylic.
   2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

   1. Polycarbonate housing.

E. Conduit: Rigid galvanized steel or Electrical metallic tubing or Flexible metallic conduit, minimum 3/4 inch (21 mm) in diameter.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position when testing emergency power unit.
   3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

E. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach fixtures directly to gypsum board.

F. Ceiling Grid Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265213
SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
   2. Luminaire supports.
   3. Luminaire-mounted photoelectric relays.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color rendering index.
C. Fixture: See "Luminaire."
D. IP: International Protection or Ingress Protection Rating
E. Lumen: Measured output of lamp and luminaire, or both.
F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of the following:
   1. Luminaire.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
   1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
1.6 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 (Five) year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598.

D. Lamp base complying with ANSI C81.61 or IEC 60061-1.

E. L70 lamp life of 35,000 hours.

F. Nominal Operating Voltage: 120 V ac.

G. In-line Fusing: On the primary for each luminaire.

H. Lamp Rating: Lamp marked for outdoor use.

2.2 LUMINAIRE TYPES

A. Area and Site: See Drawing E-117.

1. Luminaire Shape: Square.


3. Luminaire-Mounting Height: Per Drawings.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Components: Powder-coated Aluminum housing construction. Form and support to prevent warping and sagging.
C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
   1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

2.4 FINISHES

   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Wall-Mounted Luminaire Support:
   1. Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

H. Coordinate layout and installation of luminaires with other construction.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Luminaire will be considered defective if it does not pass tests and inspections.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265619
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating and filling for rough grading the Site.
   2. Preparing subgrades for slabs-on-grade and pavements.
   3. Excavating and backfilling for buildings and structures.
   4. Drainage course for concrete slabs-on-grade.
   5. Subbase course for concrete pavements.
   6. Subbase course and base course for asphalt paving.
   7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.
H. 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.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.4 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487 or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

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. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

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

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

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

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

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

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

E. Initial Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
G. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

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

3.11 SOIL MOISTURE CONTROL
A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS
A. Place backfill and fill soil 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 soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
   3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
   4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.
3.13   GRADING
A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
  1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
  2. Walks: Plus or minus 1 inch (25 mm).
  3. Pavements: Plus or minus 1/2 inch (13 mm).
C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.14   SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS
A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  1. Shape subbase course and base course to required crown elevations and cross-slope grades.
  2. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
  3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.15   DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE
A. Place drainage course on subgrades free of mud, frost, snow, or ice.
B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
  2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.16   FIELD QUALITY CONTROL
A. Special Inspections: Contractor will engage a qualified special inspector to perform inspections:
B. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 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.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000
SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes Concrete Paving.

1.  Walkway.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Joint fillers.
C. Material Test Reports: For each of the following:

   1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.6 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.

   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. 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.

1.7 FIELD CONDITIONS

A. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1.

B. Hot-Weather Concrete Placement: Comply with ACI 301 when hot-weather conditions exist:

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

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.
2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

B. 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:

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type II.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S or Class 4M, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING MATERIALS

A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

2.7 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. When available, provide history of proposed mix design breaks.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Add air-entraining admixture for concrete paving 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 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Concrete Mixtures: Normal-weight concrete.
   2. Maximum W/C Ratio at Point of Placement: 0.45.
   3. Slump Limit: 4 inches, plus or minus 1 inch.

2.8 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

3.4 STEEL REINFORCEMENT INSTALLATION

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.

3.5 JOINTS

A. General: Form 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. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

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 radius. Repeat grooving of contraction joints after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. 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 bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.
B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

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

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each concrete mixture placed each day.

2. 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.

3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM 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.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days, three specimens at 28 days and keep one specimen as a hold cylinder to be tested as required at the direction of the Architect.

   a. A compressive-strength test shall be the average compressive strengths from at least three 4 by 8 in. cylinders made from the same sample of concrete and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if every arithmetic 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. Concrete paving will be considered defective if it does not pass tests and inspections.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.10 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by the Owner.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313
SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Chain-link fences.
      2. Swing gates.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For each type of fence and gate assembly.
      1. Include plans, elevations, sections, details, and attachments to other work.

1.3 INFORMATIONAL SUBMITTALS
   A. Product certificates.
   B. Product test reports.
   C. Sample warranty.

1.4 WARRANTY
   A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and
gates that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind
loads and stresses for fence height(s) and under exposure conditions indicated according to
ASCE/SEI 7:
      1. Design Wind Load: 90 mph.
a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed 10 feet (3 m) for Material Group IA, ASTM F1043, Schedule 40 steel pipe.
b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: For 72” Standard Fence Height.
2. Steel Wire for Fabric: Minimum Wire diameter of 0.113 inch (2.87 mm).
   a. Mesh Size: 2-1/8 inches (54 mm).
3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:

1. Fence Height: 72 inches (1830 mm).
   a. Line Post: 1.9 inches (48 mm) in diameter.
   b. End, Corner, and Pull Posts: 2.375 inches (60 mm).
4. Metallic Coating for Steel Framework:
   a. Type A zinc coating.
   b. Type B zinc with organic overcoat.
   c. External, Type B zinc with organic overcoat and internal, Type D zinc-pigmented coating.
   d. Type C, Zn-5-Al-MM alloy coating.
   e. Coatings: Any coating above.

2.4 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire according to ASTM A817 or ASTM A824, with the following metallic coating:

1. Type I: Aluminum coated (aluminized).
2. Type II: Zinc coated (galvanized) with minimum coating weight matching chain-link fabric coating weight.
3. Type III: Zn-5-Al-MM alloy with the following minimum coating weight matching chain-link fabric coating weight.

2.5 SWING GATES

A. General: ASTM F900 for gate posts and single or double swing gate types.
   1. Gate Leaf Width: 36 inches (914 mm).
   2. Framework Member Sizes and Strength: Based on gate fabric height of 72 inches (1830 mm) or less.

B. Pipe and Tubing:
   1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.

C. Frame Corner Construction: Welded or assembled with corner fittings.

D. Hardware:
   1. Hinges: 360-degree inward and outward swing.
   2. Padlock and Chain. Confirm with Owner Requirements.

2.6 FITTINGS

A. Provide manufacturer’s standard fittings according to ASTM F626.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
      a. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches (127 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

D. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric.

E. Chain-Link Fabric: Apply fabric to outside or inside of enclosing framework. Leave 1-inch (25-mm) bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

3.4 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323113