ADELANTE ACADEMY II –
HVAC REPLACEMENT

1970 CINDERELLA LN.,
SAN JOSE, CA 95116

ALUM ROCK UNION ELEMENTARY SCHOOL DISTRICT

DSA File No. 43-4
App. No. 01-120630
PTN. 69639-90

APRIL 24, 2023

PROJECT #22025

Studio W Architects

STUDIO W
ARCHITECTS

SEALS PAGE

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 01-120630 INC:
REVIEWED FOR
SS ☑ FLS ☑ ACS ☑
DATE: 5/3/2023

Alum Rock Union School District
22025- Adelante Academy II – HVAC Replacement

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REGISTERED PROFESSIONAL ENGINEER
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well beyond design.

MECHANICAL/PLUMBING/ELECTRICAL ENGINEER:

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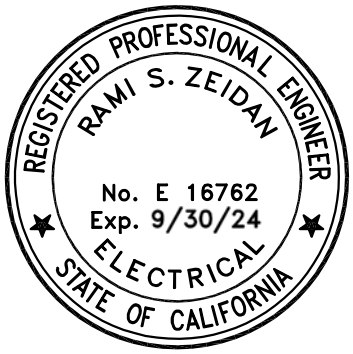
BY:_____

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BY:_____

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SECTION 011000 - SUMMARY

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 the following:
1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Use of premises.
5. Work restrictions.
6. Specification formats and conventions.
7. Pollution Control.
8. Storm Water Pollution Prevention Plan.
9. Lead-Containing materials.
10. Additional DSA requirements.

B. Related Sections include the following:
1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Adelante Academy II - HVAC Replacement

B. Owner: Alum Rock Union Elementary School District

C. Architect: Studio W Architects.

D. The Work consists of the following:
1. The Work includes HVAC & roofing replacement with various site improvements and restroom accessibility upgrades.
2. The intent of these drawings and specifications is that the alteration, rehabilitation or reconstruction is to be in accordance with Title 24, California Code of Regulations. Should any existing conditions such as deterioration or non-complying construction be discovered which is not covered by the contract documents wherein the finished work will not comply with Title 24, California Code of Regulations, a Construction Change Document, or a separate set of plans and specifications, detailing and specifying the

required repair work shall be submitted to and approved by Division of the Sate Architect before proceeding with the repair work.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 WORK PHASES

A. The Work shall be conducted in single phases as indicated on Drawings.

1.6 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.7 WORK RESTRICTIONS

A. On-Site Work Hours:
1. Work shall be generally performed inside the existing building during normal business working hours of 8 a.m. to 5 p.m., Monday through Friday, except otherwise indicated.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 49-division format and CSI's MasterFormat 2004 numbering system.
1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
   a. 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.

1.9 POLLUTION CONTROL

A. Provide positive methods, means and facilities required to prevent contamination of the soil, water or atmosphere by the discharge of noxious substances from the construction operations.

1.10 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The contractor shall submit a Storm Water Pollution Prevention Plan for approval by the City's Public Works and Community Development Departments. The plan shall show erosion control measures and indicate locations of staging, fueling, equipment and employee parking, and storage/stockpile locations. Locations for concrete washout shall be shown, as well as gravel site entrances and/or metal grates to keep soil from being deposited on City streets. The plan shall note that street sweeping shall occur as often as necessary, to ensure that no dirt or dust will remain on City streets. Drip pans shall be used under parked equipment and visqueen shall be shown on the plan to protect the soil in the fueling area. Only minor vehicle maintenance shall occur on-site. Maintenance shall occur in the fueling area and soil shall be protected by drip pans and visqueen.

B. Prepare a Storm Water Pollution Prevention Plan (SWPPP) and file a Notice of Intent with the State Water Resources Control Board for this project. The SWPPP will provide Best Management Practice (BMP) methods and controls for wet weather grading activities and erosion control for both onsite and offsite improvements, in accordance with the requirements of the NPDES General Permit for Storm Water Discharges Associated with Construction Activity. The SWPPP shall include an erosion control plan.

1.11 MISCELLANEOUS PROVISIONS

A. General: Comply with the Project Conditions of Approval for both noise and dust control. If there is any conflict between drawings and specifications and the Project Conditions of Approval regarding noise and dust control, the Project Conditions of Approval shall govern.

B. Noise Control: The Contractor shall install noise reducing devices on construction equipment. Contractor shall comply with the requirements of the city and county having jurisdiction with regard to noise ordinances governing construction sites and activities. Construction Equipment noise at the Site shall be limited and only as permitted by applicable law, rule or regulation. If classes are in session at any point during the progress of the Work, and, in the Owner's reasonable discretion, the noise from any Work disrupts or disturbs the students or faculty or the normal operation of Owner, at the Owner's request, the Contractor shall schedule the performance of all such Work around normal hours or make other arrangements so that the

Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.

C. Dust Control. The Contractor shall be fully and solely responsible for maintaining and upkeeping all areas of the Site and adjoining areas, outdoors and indoors, free from flying debris, grinding powder, sawdust, dirt and dust as well as any other product, product waste or work waste, that by becoming airborne may cause respiratory inconveniences to persons, particularly to students and Owner's personnel. Additionally, the Contractor shall take specific care to avoid deposits of airborne dust or airborne elements. Such protection devices, systems or methods shall be in accordance with the regulations set forth by the EPA and OSHA, and other applicable law, rule or regulation. Additionally, the Contractor shall be the sole party responsible to regularly and routinely clean up and remove any and all deposits of dust and other elements. Damage and/or any liability derived from the Contractor's failure to comply with these requirements shall be exclusively at the cost of the Contractor, including, without limitation, any and all penalties that may be incurred for violations of applicable law, rule or regulation, and any amounts expended by the Owner to pay such damages shall be due and payable to the Owner on demand. Contractor shall replace any damages property or part thereof and professionally clean any and all items that become covered or partially covered to any degree by dust or other airborne elements. If classes are in session at any point during the progress of Work, and, in the Owner's reasonable discretion, flying debris, grinding powder, sawdust, dirt or dust from any Work disrupts or disturbs the students or faculty or the normal operation of the college, at the Owner's request, the Contractor shall schedule the performance of all such Work around normal college hours and make other arrangements so that the Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.

1.12 LEAD-CONTAINING MATERIALS.

A. The Contractor shall assume that all ceramic tile and painted or varnished surfaces in the school district contain detectable levels of lead which trigger compliance with California Code of Regulation, Title 8, Section 1532.1. In addition, waste products from these materials could contain lead at levels which are subject to the hazardous waste requirements in the California Code of Regulations, Title 22, Sections 666260.1 - 66263.12 and 66268.1 - 66268.124 and the health and Safety Code Section 25157.8 and 25163, subdivision (c).

B. It is the Contractor's responsibility to handle and dispose of these materials in accordance with the regulations. If failure to comply with these regulations results in a site or worker contamination, the Contractor will be held solely responsible for all costs involved in any required corrective action.

C. Lead-based paint should be removed only by professionals trained in hazardous material removal. A trained professional must follow very detailed procedures to minimize, control and contain lead dust generated by the removal process.
   1. The room should be sealed from the rest of the building. All furniture, carpets and drapes should be removed.
   2. Workers should wear respirators designed to avoid inhaling lead.
   3. No eating or drinking should be allowed in the work area. All food and eating utensils should be removed from the room. All cabinets as well as food contact surfaces should be covered and sealed.

4. Occupants should be kept out of the room until the job is completed.
5. Clothing worn in the room should be disposed of after working. The work clothing should not be worn in other areas of the building.
6. Debris should be cleaned up using special vacuum cleaners with HEPA (high efficiency particle absorption) filters. A wet mop should be used after vacuuming.

1.13 ADDITIONAL DSA REQUIREMENTS

A. Comply with the following:
   1. Compliance with Title 24, for Parts 1-6 and 9.
   2. Title 24, Parts 1-5 shall be kept on site during construction.
   3. If any conflict or inconsistencies exist between the specifications and the drawings (including the general notes), more stringent requirements shall take precedence.
   4. Addenda:
      a. In accordance with Section 4-338(a) of the California Administrative Code, changes or alterations of the approved plans and specifications prior to the letting of a construction contract for the Work shall be made by means of addenda, which shall be submitted to and approved by Division of the Sate Architect (DSA) prior to distribution to contractors.
      b. Addenda shall be stamped and signed by Architect or Engineer in general responsible charge of preparation of the plans and specifications, and by the Architect or Engineer delegated responsibility for the portion affected by the addenda.
      c. Addenda issued during bidding, if any, will be inserted following this page in the Contract Documents sets issued for construction. The provision of all addenda shall become part of the Contract Documents and Contractor shall be obligated to construct the Project in accordance with the Contract Documents as modified or supplemented by the addenda provisions.
   5. All substitutions affecting DSA regulated items shall be considered as a Construction Change Document or Addenda, and shall be approved by DSA prior to fabrication and installation. (IR-A6) (Section 4-338(c), Part 1)
   6. Construction Change Document (Section 4-338 (c), Part 1) must be signed by all the following:
      a. A/E of Record.
      b. Owner (change order only).
      c. SEOR (when applicable).
      d. Delegated Professional Engineer (when applicable).
      e. DSA.
   7. Project Inspector and testing lab must be employed by the Owner and approved by all of the following:
      a. A/E of Record.
      b. SEOR (when applicable).
      c. DSA.

B. Tests and Inspections - Chapter 17A:
   1. All tests shall be performed by a testing facility acceptable to the architect and DSA. The testing facility shall be directly employed by the school district and no other entity or individual. Section Title 24, Part 1, Section 4-333 and 4-335.

2. Test reports shall be addressed to, and sent to, the school district by the testing facility. Copies of all test reports shall be sent to DSA, the architect, the structural engineer, and the project inspector by the testing facility. All reports shall be sent within 14 days of the date of the test. See Title 24, Part 1, Section 4-333 and 4-335.
3. A Verified Report, sighed by the California licensed civil engineer in charge of the testing facility which conducted the tests, shall be submitted to DSA upon completion of the project. The verified report shall state that all tests and inspections were made as required by the DSA approved documents. If the tests or inspections indicate that materials or workmanship did not meet the requirements of the DSA approved documents, the Verified Report shall list all noncompliant work. A copy of all test reports involving unresolved noncompliant work shall be attached to the Verified Report. In the event that not all required tests or inspections were made by the testing facility making this verified report, those tests and inspections not made shall be listed on the Verified Report. See Title 24, Part 1, Section 4-333 and 4-335.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

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 "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect may issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, or Changes not affecting the Structural Safety, Access Compliance or Fire & Life Safety portions of the work, on AIA Document G710, "Architect's Supplemental Instructions" or an equivalent form acceptable to District and subject to DSA IR A-6 Construction Change Document Submittal and Approval Process (Title 24, Part 1, California Code or Regulations, Section 4-338) requirements for DSA Construction Change Document – Category B.

1.4 PROPOSAL REQUESTS (BULLETIN)

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

d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

1.5 CONSTRUCTION CHANGE PROCESS - DSA

A. Changes or alterations of the approved plans or specifications after a contract for the work has been let affecting the Structural, Access or Fire-Life Safety portions of the project shall be made only by means of Construction Change Documents submitted to and approved by DSA prior to commencement of the work shown thereon. Construction Change Documents shall comply with DSA IR A-6 Construction Change Document Submittal and Approval Process (Title 24, Part 1, California Code or Regulations, Section 4-338) requirements. Construction Change Documents shall be made using DSA form 141 and state the reason for the change and the scope of work to be accomplished, and, where necessary, shall be accompanied by supplementary drawings referenced in the text of the change order. All Construction Change Documents and supplementary drawings shall be stamped and signed by the architect or engineer in general responsible charge of observation of the work of construction of the project and by the architect or registered engineer delegated responsibility for observation of the portion of the work of construction affected by the change order, shall bear the approval of the school board and shall indicate the associated change in the project cost, if any. One copy of each Construction Change Documents is required for the files of DSA.

B. Construction Change Documents shall be signed by Architect of Record, Owner, Structural Engineer (when applicable), Delegated Professional Engineer (when applicable), and DSA.

C. No changes shall be made to approved documents without DSA approval.

D. All Construction Change Documents shall be signed by Architect and approved by DSA.

1.6 CONSTRUCTION (FIELD) CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

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 necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets.
      b. Submittals Schedule.
      c. Contractor's Construction Schedule.
   2. Submit the Schedule of Values to Architect at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.
   3. No payment applications will be signed by the Architect prior to the Contractor submitting, and the Architect reviewing, a schedule of values.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Submit draft of AIA Document G703 Continuation Sheets.

3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value.
      1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times:
   1. The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   6. Submittals Schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   11. Initial progress report.
   12. Report of preconstruction conference.
   13. Certificates of insurance and insurance policies.
   14. Data needed to acquire Owner's insurance.
   15. Initial settlement survey and damage report if required.

G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."

6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 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 Project including, but not limited to, the following:
   1. Project meetings.
   2. Requests for Interpretation (RFIs).

B. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for electronic submittals.
   2. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
   3. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   4. Division 1 Section "Closeout Procedures" 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, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

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. Project closeout activities.
8. Startup and adjustment of systems.
9. 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. Submit electronic submittals directly to extranet specifically established for Project.

1.5 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
4. Frequency of Attendance by Architect: Limited by Architect/Owner Contract.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Phasing, if any.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for RFIs.
    g. Procedures for testing and inspecting.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.
    k. Preparation of Record Documents.
    l. Use of the premises.
    m. Work restrictions.
    n. Owner's occupancy requirements.
    o. Responsibility for temporary facilities and controls.
    p. Construction waste management and recycling.
    q. Parking availability.
    r. Office, work, and storage areas.
    s. Equipment deliveries and priorities.
    t. First aid.
    u. Security.
    v. Progress cleaning.
    w. Working hours.
3. Minutes: Record and distribute meeting minutes electronically.

C. Preinstallation Conferences: 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 Architect 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. The Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Review of mockups.
    i. Possible conflicts.
    j. Compatibility problems.
    k. Time schedules.
    l. Weather limitations.
    m. Manufacturer's written recommendations.
    n. Warranty requirements.
    o. Compatibility of materials.

p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to 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.

D. Progress Meetings: Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
1) Review schedule for next period.
b. Review present and future needs of each entity present, including the following:
1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.

15) RFIs.
16) Status of proposal requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

3. Minutes: Record the meeting minutes electronically.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.6 RFIs:

A. General:
1. Contractor may submit a RFI to the Architect seeking clarification or interpretation of the contract documents. If in the Contractor's opinion the nature of the RFI requires a discussion, rather than simply an answer, the Contractor shall call the Architect to have such a discussion. The results of that discussion as well as all other RFI's must be presented in writing on a form approved in advanced by the Architect along with any supporting information or data, as well as the Contractor's recommended resolution. An oral RFI or a RFI presented on an unapproved form, or without adequate supporting information and Contractor's recommended solution, will be attributed solely to the contractor. Architect's review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction means, methods, techniques, sequences, or procedures of the Contractor.
2. Architect's review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures, or methodology of the Contractor.
3. The use of a RFI is limited to clarification of the contract documents. Contractor will limit each RFI to a single issue. Information which is discernable from the contract documents; construction means and methods; product substitution submittals; product submittals; and construction site safety will not be addressed by the Architect in responding to a RFI.
4. Architect's response to a RFI is not a change order or directive authorizing an increase in construction cost or time.

B. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. Frivolous or Unnecessary RFIs: Cost of design professional’s time will be billed or deducted from progress payment.

D. Electronic RFIs: Follow vendor's instruction.
   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow 21 days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
   1. The following RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for coordination information already indicated in the Contract Documents.
      d. Requests for adjustments in the Contract Time or the Contract Sum.
      e. Requests for interpretation of Architect's actions on submittals.
      f. Incomplete RFIs or RFIs with numerous errors.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
   3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

F. RFI Log: Prepare, maintain, and submit as instructed by electronic submittal vendor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FORMS

A. Electronic versions of attached forms will be provided upon request.
   1. RFI Form.

END OF SECTION 013100

STUDIO W
ARCHITECTS

RFI FORM

Project Name: **RFI No.:**
Project No.:
To: **Date:**
From:

Subject:
Discipline: **Category:**
Specification Section Title:
Section No.: **Page:** **Article/Paragraph:**
Sheet No.: **Detail:**

Question:

Suggestion:
☐ **Attachment:**
Undersigned certifies:

- Both drawings and specification sections were thoroughly reviewed.
- Processing time for frivolous RFIs will be charged back to Contractors at A/E billable rates.

Desired Response Date: (However, A/E still have specified days to respond.)
Cost Impact: **Schedule Impact:** days
Drawing Impact: **Submitted by:**
Signed: **Date:**

Answer:

Answered by:
Signed: **Date:**

Copies: ☐ **Owner** ☐ **Consultants** ☒ ☐
☐ **File**

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1. A/E review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures, or methodology of the Contractor.
2. The use of a RFI is limited to clarification of the contract documents. Contractor will limit each RFI to a single issue. Information that is discernable from the contract documents; construction means and methods; product substitution submittals; product submittals; and construction site safety will not be addressed by the A/E in responding to a RFI.
3. A/E response to a RFI is not a change order or directive authorizing an increase in construction cost or time.

End of RFI Form

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

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 for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's Construction Schedule.
   2. Submittals Schedule.
   3. Three Week Look-Ahead Schedule.
   4. Daily construction reports.

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 SUBMITTALS

A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal.
   2. Specification Section number and title.
   3. Submittal category (action or informational).
   4. Name of subcontractor.
   5. Description of the Work covered.
   6. Scheduled date for Architect's final release or review.

B. Contractor's Construction Schedule: Submit three opaque copies of schedule, large enough (minimum 11 x 17) to show entire schedule for entire construction period.

C. Daily Construction Reports: Submit two copies at weekly intervals.

1.4 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Concurrent with the development of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the submittal schedule with the Contractor's construction schedule described above.
   1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
   2. The Architect will review the schedule and indicate which submittals may be deleted from the submission requirement. The deletion of the submittal requirement for an item does not release the Contractor from any requirements of the Construction Contract, General Conditions or Plans and Specifications.

B. Prepare the schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:
   1. Scheduled date for the first submittal.
   2. Related Section number.
   3. Submittal category.
   4. Name of subcontractor.
   5. Description of the part of the Work covered.
   6. Scheduled date for resubmittal.
   7. Scheduled date the Architect's final release or review.

C. Distribution: Following response to initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.
   1. 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 portion of the Work and are no longer involved in construction activities.

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

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit within 15 days of the date established for "Commencement of the Work". The Construction Schedule must be submitted and accepted prior to approval of first pay application.
   1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as identified in the "Schedule of Values".
   2. Within each time bar indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.
   3. Prepare the schedule on a sheet, or series of sheets, of stable reproducible media, of sufficient width to show data for the entire construction period.
   4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically 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 schedules.
   6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit work by separate Contractors and partial occupancy by the Owner prior to Substantial Completion.

C. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.

D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.

E. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating "pre-calculated" and "actual" costs. On the line show dollar-volume of work performed as of the dates used for preparation of payment requests.
   1. Refer to Section "Payment Procedures" for cost reporting and payment procedures.

2.3 THREE WEEK LOOK-AHEAD SCHEDULE

A. Prepare weekly (or as determined by scheduled meeting times), prior to Project meetings, a computer-generated 3-week look-ahead schedule (bar chart) which is consistent with the Contractors schedule and depicts daily labor activities. The schedule will consist of the prior week, current week and the following 3 weeks.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions.
   7. Accidents.
   8. Meetings and significant decisions.
   9. Unusual events (refer to special reports).
   10. Stoppages, delays, shortages, and losses.
   11. Meter readings and similar recordings.
   12. Emergency procedures.
   13. Orders and requests of authorities having jurisdiction.
   14. Change Orders received and implemented.
   15. Construction Change Directives received and implemented.
   16. Services connected and disconnected.
   17. Equipment or system tests and startups.
   18. Partial Completions and occupancies.
   19. Substantial Completions authorized.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates changes, including, but not limited to, changes in durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of reviewed schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.2 FORMS

A. Electronic versions of attached forms will be provided upon request.
   1. Submittals Schedule Form.

END OF SECTION 013200

SUBMITTAL SCHEDULE FORM

☐ Preliminary Submittal Schedule: Include submittals required during the first 60 days of construction.
☐ Complete Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

Project: From:

To: Date:

Scheduled Initial Submittal Date	Spec Section		Type: ☐ Action ☐ Info Only	Name of Subcontractor	Description	Scheduled Date of Approval
	No.	Title				

End of Submittal Schedule Form

SECTION 013300 - SUBMITTAL PROCEDURES

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 for electronically submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Consult individual sections of specifications for specific submittals required under those sections and for further details and descriptions of requirements.

C. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
   3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
   4. Division 1 Section "Quality Requirements" for submitting test and inspection reports.
   5. Division 1 Section "Closeout Procedures" for submitting warranties.
   6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   7. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   8. Division 1 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
   9. Other Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. Processing: All costs for electronic submittal, printing, preparing, packaging, mailing, or delivering submittals for initial submittals and all costs for re-printing, re-drawing, re-drafting, re-packaging, re-submitting, and re-mailing or re-delivering as required for all re-submittals shall be included in Contract Sum.

B. Sequence: Transmit each submittal in sequence which will not result in Architect's approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

E. Multiple Reviews: The Contractor shall also be responsible for all costs to Architect or Architect consultants for reviews requiring more than 2 reviews for same specification section.

F. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Review: Allow 21 days for review of each submittal. Architect will request for more time if needed.

G. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked "Approved" or "Furnish as Noted".

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Use only final submittals with mark indicating approval by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Submit request using attached form at end of section.
      a. Indicate date, project name, contractor name, address, and specific drawing (sheet number) required.
      b. Signed by Contractor agreeing with terms and conditions.

PART 2 - PRODUCTS

2.1 ELECTRONIC SUBMITTALS

A. General: Prepare and submit Submittals required by individual Specification Sections.
   1. Submit electronic submittals directly to extranet specifically established for Project.
   2. Vendor:
      a. Submittal Exchange (Basis of Design)
      b. Or equal.
   3. Contractor shall pay for all-inclusive use of Submittal Exchange by all project team members; data storage, security, and backup; setup, training, and support; and archiving once construction is complete.
      a. Documentation processed, housed and archived shall include but not limited to: Submittals, Addendum, Plans, Specs, Field Reports, Photos, Weekly Reports, Notice of deviations, Punch List, RFI's RFP's ASI's, CCD's, Cost Proposals, Test Reports, Meeting Notes., and Close Out.

2.2 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
      a. Circle items applicable.
      b. Cross-out items not applicable.
      c. Select item number if required.
   3. Submittal data must include complete documentation relating to all the specified features
   4. Include the following information, as applicable:
      a. Manufacturer's Submittal Form with all the options selected when available.
      b. Manufacturer's written recommendations.
      c. Manufacturer's product specifications.
      d. Manufacturer's installation instructions.
      e. Standard color charts.
      f. Manufacturer's catalog cuts.
      g. Wiring diagrams showing factory-installed wiring.

h. Printed performance curves.
i. Operational range diagrams.
j. Mill reports.
k. Standard product operation and maintenance manuals.
l. Compliance with specified referenced standards.
m. Testing by recognized testing agency.
n. Application of testing agency labels and seals.
o. Notation of coordination requirements.

5. Submit Product Data before or concurrent with Samples.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Dimensions.
   b. Do not use words "by others." Identify exactly who is responsible for the work.
   c. Identification of products.
   d. Fabrication and installation drawings.
   e. Roughing-in and setting diagrams.
   f. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
   g. Shopwork manufacturing instructions.
   h. Templates and patterns.
   i. Schedules.
   j. Design calculations.
   k. Compliance with specified standards.
   l. Notation of coordination requirements.
   m. Notation of dimensions established by field measurement.
   n. Relationship to adjoining construction clearly indicated.
   o. Seal and signature of professional engineer if specified.
   p. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
3. Number of Copies: Submit 4 sets of prints and one electronic copy.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.

F. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

G. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."

H. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

2.3 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be

signed by an officer or other individual authorized to sign documents on behalf of that entity.

2. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

L. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment.

Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

2.4 DEFERRED APPROVALS

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
   1. Coordinate the work; do not delegate responsibility for coordination to any subcontractor.
   2. Anticipate the interrelationship of all subcontractors and their relationship with the total work.
   3. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of work between sections.
   4. Trade submittals with “By Others”, “By General Contractor”, or similar coordination and work scope are not allowed. Identify, acknowledge, and resolve scope of work prior to submittal by Contractor. No extras will be allowed. Provide complete and coordinated submittals.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. Architect's and Consultant's review shall neither be construed as complete check nor relieve the Contractor, Subcontractor, manufacturer, fabricator, or supplier from responsibility for any deficiency that may exist or from any departures or deviations from the requirements of the Contract unless the Contractor has, in writing, called the Architect's attention to the deviations at the time of submission as specified.

3.3 FORMS

A. Electronic versions of attached forms will be provided upon request.
   1. Electronic Files Transfer - Architectural Form.

END OF SECTION 013300

Subject: Architectural Electronic Files

Date: _____

Contractor Name: _____

Address: _____

Project: _____

At your request, we will provide electronic files for your convenience and use in the preparation of shop drawings related to _____, subject to the following terms and conditions:

Our electronic files are compatible with AutoCAD. We make no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications.

Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or sub consultants that may arise out of or in connection with your use of the electronic files.

Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files.

These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.

Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display.

We will furnish you electronic files of the following architectural drawings: _____.

Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by us, and we make no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files.

If these terms are acceptable to you, please sign in the space provided below as evidence of our mutual understanding and agreement for this service. One signed copy of this agreement shall be returned to our office prior to delivery of the electronic files.

Very truly yours,

Architect

_____ _____

SECTION 014000 - QUALITY REQUIREMENTS

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 for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:
   1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   2. Other Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups:

1. Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
2. Comprehensive, completely integrated mockups of separate trades showing interface conditions, transitions, and relationships between materials and finishes.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of 5 previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

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

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A licensed professional engineer who is legally qualified to practice in California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An DSA approved NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.7 QUALITY CONTROL

A. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

E. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
   1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

F. All work shall be in compliance with 2019 Title 24, Parts 1-6 and 9.

G. 2019 Title 24, Parts 1-5 shall be kept on site during construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 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 list of references.

1.3 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. “AHJ”: Agency having jurisdiction.

C. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

D. “Compatible”: When used for products, it shall comply with requirements including products recommended/ required by the manufacturer for warrantee acceptance.

E. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

F. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

G. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

H. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

I. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

J. “Owner”: As defined in Division 1 section “Summary”.

K. "Provide": Furnish and install, complete and ready for the intended use.

L. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
   2. Copies of standards and applicable building codes (Title 24 Parts 1-5) shall be kept on-site during construction.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.

E. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

F. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

G. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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 requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:
1. Division 1 Section "Summary" for limitations on utility interruptions and other work restrictions.
2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Division 1 Section "Execution Requirements" for progress cleaning requirements.
4. Other Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service:
1. Owner's existing sewer system is available for use without metering but will be billed to Contractor for use charges.

C. Water Service:
1. Water from Owner's existing water system is available for use without metering but will be billed to Contractor for use charges. Provide connections and extensions of services as required for construction operations.

D. Electric Power Service:

1. Electric power from Owner's existing system is available for use without metering but will be billed to Contractor for use charges. Provide connections and extensions of services as required for construction operations.

E. Sanitary Facilities:
1. Pay sanitary service use charge for temporary toilets, wash facilities, and drinking water for use of construction personnel.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with 2019 CEC.

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

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized steel bases for supporting posts.

B. Wind Screen Fabric: Green.

2.2 TEMPORARY FIELD OFFICES

A. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading located within construction area or within 30 feet of building lines. Comply with NFPA 241.

B. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

C. Sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices and pay for services for following:
   1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
   2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack board.
   3. Drinking water and private toilet.
   4. Coffee machine and supplies.
   5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
   7. Internet access:
      a. DSL or Cable (if available) service separate from the dedicated telephone line to field office and Inspector's/Architect's field office at time of project mobilization. Provide high speed connection, maintain and pay for usage.
      b. Internet access shall be through wireless WiFi router, 100 Mbps minimum.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, electric, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

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

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Install temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Install temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Install temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Install electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

H. Lighting: Install temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign.

3.3 SUPPORT FACILITIES INSTALLATION

A. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

B. Parking: Provide temporary or use designated areas of Owner's existing parking areas if approved for construction personnel.

C. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations.

D. Project Identification and Temporary Signs: Provide Project identification. Install signs where directed to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
   1. Provide temporary, directional signs for construction personnel and visitors.
   2. Maintain and touchup signs so they are legible at all times.
   3. Provide a 4'-0" x 8'-0" project sign constructed of 1/2 inch plywood or 10 mil corrugated mounted to 4"x4" posts 8'-0" long set 2'-0" deep into earth.
   4. Project sign shall include a graphic of the building (available from the Architect), Architect, Consultants, District, project, funding members with titles, and Contractor with contact information for the contractor. Text and layout shall be submitted for approval prior to installation.
   5. Location of project sign shall be coordinated with District's representative.

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

F. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Division 1 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
   1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations or as indicated on Drawings.
   2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

F. Install full coverage with green wind screen fabric to block viewing through construction fencing. Wind screen fabric shall be anchored or weighted sufficiently to resist design wind loads indicated on Drawings.

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

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

J. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
   1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
   2. Construct dustproof partitions with 2 layers of 3-mil polyethylene sheet on each side. Cover floor with 2 layers of 3-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
      a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
   3. Insulate partitions to provide noise protection to occupied areas.
   4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
   5. Protect air-handling equipment.
   6. Weather strip openings.
   7. Provide walk-off mats at each entrance through temporary partition.

K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with 2019 CFC Article 87.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

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 for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and product substitutions.

B. Related Sections include the following:
   1. Division 1 Section "References" for applicable industry standards for products specified.
   2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
   3. Other Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Proposed products by manufacturers not listed in Manufacturers list.

C. Basis-of-Design: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating “or equal” products of other named manufacturers.

D. District Standard: Where a specific manufacturer's product is named and accompanied by the words "District Standard," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics pre-selected by the District.
   1. District seeks to match products currently in use on other campuses; No substitution allowed.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. Form: Tabulate information for each product under the following column headings:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.
      g. Projected delivery date or time span of delivery period.
      h. Identification of items that require early submittal approval for scheduled delivery date.
   3. Completed List: Submit 3 copies of completed product list within days specified in General Conditions. Include a written explanation for omissions of data and for variations from Contract requirements.
   4. Architect's Action: Architect will respond in writing to Contractor within 21 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form provided at end of Section.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.
      b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, environmental, and specific features and requirements indicated.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: Architect will notify Contractor of acceptance or rejection of proposed substitution within 21 days of receipt of request.
   a. Form of Acceptance: Change Order.
   b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. All substitutions affecting the Structural, Access or Fire-Life Safety portions of the project shall be submitted to DSA for approval as a Construction Change Directive in accordance with DSA IR A-6 Construction Change Document Submittal and Approval Process (Title 24, Part 1, California Code or Regulations, Section 4-338) requirements.

D. The cost for any additional design or engineering required to gain DSA approval of a substitution shall be borne solely by the contractor. Any delay impacts resulting from DSA review and approval of substitutions shall be borne solely by the contractor.

E. Named Product and Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

F. District Standard Products Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Changes to the approved drawings and specifications shall be made by an addendum or a Construction Change Document approved by the Division of the State Architect, as required by Section 4-338, Part 1, Title 24, CCR.

B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
   3. Refer to other sections for specific content requirements and particular requirements for submitting special warranties.

C. Warranty Period: Warranty period specified in each sections are minimum requirements. Do not modify manufacturer’s standard warranty period if the manufacturer’s warranty has longer warranty period.

D. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
   6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
   3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   5. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or an equal product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with “or equal”.

6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Product Substitutions" Article to obtain approval by Architect for use of an unnamed product.
7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include custom or premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes standard, custom, and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 35 days after the Notice to Proceed**.** Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction and has paid any fees.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

11. Furnish samples upon requested by Architect.
12. Attached Request for Substitution Form shall used for substitution requests.

C. Substitutions for products or systems involving structural, fire/life safety and access compliance will be considered a Construction Change Document or Addendum, and will require DSA approval. This will add time required to review those substitutions requiring DSA approval. Contractor is solely responsible for all documentation and time required to obtain DSA approval.
   1. The use of a product other than specified or noted on the Drawings will require the Contractor to get Engineer, Architect and DSA approval.
   2. The Contractor shall be responsible to provide any information, calculations or drawings to show compliance with the DSA approved drawings and provide all documentation to the Architect and/or Engineer of record.
   3. Any changes or "substitutions" that impact or relate to DSA requirements for structural, ADA or fire and life safety MUST be approved by DSA prior to proceeding with the work.
   4. The Contractor shall also be responsible for all costs to the DSA, Architect or Architect consultants for review, co-ordination, and approval by the DSA.
      a. All costs for submittal to DSA and Architect/ design team expenses shall be back charged to the Contractor.

PART 3 - EXECUTION

3.1 FORMS

A. Electronic versions of attached forms will be provided upon request.
   1. Product List Form.
   2. Similar Installation List Form.
   3. Substitution Request Form.

END OF SECTION 016000

SUBSTITUTION REQUEST FORM

Substitutions are only allowed within number of days specified. Use this for m for requesting "or equal" products and materials.

Project:	Substitution Request Number:
	From:
To:	Date:
	Project Number:

Specification Section Title:		
Section Number:	Page:	Article/Paragraph:
Specified Item:		

Proposed Substitution:	
Manufacturer:	Address:
Contact Name:	Phone Number:
☐ Comparison between proposed substitution and specified product is attached. Note all differences.	

Reason for not using specified item:
☐ Specified product is no longer available.
☐ Substitution will improve lead time by _____ days
☐ Substitution will save Owner $ _____
☐ Other:

☐ List 3 similar installations including project name, address, owner, and date installed is attached.
Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explanation attached.

Supporting Data Attached:
☐ Product Data (indicate any options to be included)
☐ Drawings ☐ Test Reports ☐ Samples ☐ Color Chart ☐ Other:

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable is available.
- Proposed substitution will not affect or delay Construction Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including architectural or engineering design, detailing, and construction costs caused by the requested substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

- Substitutions for products or systems involving structural, fire/life safety and access compliance will require AHJ approval. This will add time required to review those substitutions requiring AHJ approval. Contractor is solely responsible for all documentation, cost, and time required to obtain AHJ approval.

Submitted by:	Firm:
Signature:	Date:
Comments:	

A/E Review:
☐ Approve Substitution.
☐ Approve Substitution as Noted.
☐ Reject Substitution. Use specified product.
☐ Reject Substitution. Use specified product. Substitution request received too late.

Signed by:	Date:
Comments:	

Owner's Review and Action (Approval of substitution is not valid without Owner's signature)
☐ Substitution approved.
☐ Substitution approved as Noted.
☐ Substitution rejected. Use specified product.

Signed by:	Date:

Comments:

End of Substitution Request Form

PRODUCT LIST FORM

☐ Preliminary Product List.
☐ Complete Product List.
Include a written explanation for omissions of data and for variations from Contract requirements.

Project: ______________________________ From: ____

To: ______________________________ Date: ____

Spec Section		**Early approval?**	**Product**	**Model No.**	**Manufacturer**	**Supplier**	**Installer**	**Delivery Date**
No.	**Title**	☐ **Yes** ☐ **No**						

End of Product List Form

SIMILAR INSTALLATION LIST FORM

Provide minimum 5 similar installations within last 3 years.

Project: _____ From: _____

To: _____ Date: _____

	Date of Installation	Project Name	Owner Info	GC Info	Architect info
1					
2					
3					
4					
5					
6					
7					
8					

End of Similar Installation List Form

SECTION 017300 - EXECUTION REQUIREMENTS

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 general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. General installation of products.
   2. Progress cleaning.
   3. Starting and adjusting.
   4. Protection of installed construction.
   5. Correction of the Work.

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
   2. Division 1 Section "Submittal Procedures" for submitting surveys.
   3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.5 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Provide protection against weather, rain, wind, storms, frost and heat so as to maintain all work and materials free from injury or damage.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.7 CORRECTION OF THE WORK

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

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes 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 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.
   2. Division 2 Section "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

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

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition 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.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 75 percent by weight of total waste generated by the Work.

1.5 QUALITY ASSURANCE

A. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 1 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

3.1 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

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

3.3 DISPOSAL OF WASTE

A. General: 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.

B. Burning: Do not burn waste materials.

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

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

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 for contract closeout, including, but not limited to, the following:
   1. IOR's Inspection procedures.
   2. Warranties.
   3. Extra Materials.
   4. Final cleaning.
   5. DSA project closeout and Final Certification of Construction.

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
   3. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Other Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 DEFINITIONS

A. IOR: Inspector of Record.

B. Inspection: IOR will inspect, not the Architect.

1.4 SUBMITTALS

A. Submit a copy of Title 24 Certificate of Acceptance forms submitted to enforcement agency.

1.5 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting IOR's inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. IOR's Inspection: Submit a written request for IOR's inspection for Substantial Completion. On receipt of request, Architect will either proceed with IOR's inspection process or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after IOR's inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.6 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final IOR's inspection for determining date of Final Completion, complete the following:
   1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
   2. Submit certified copy of Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. IOR's Inspection: Submit a written request for final IOR's inspection process for acceptance. On receipt of request, Architect will either proceed with IOR's inspection process or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after IOR's inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1.8 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date specified in General Conditions.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Include Table of Contents.
3. Identify content with specification section number and title.
4. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

5. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

1.9 EXTRA MATERIALS

A. Deliver to Owner’s facility manager extra materials specified in each section.

B. Organize submitted materials in orderly sequence based on the table of contents of the Project Manual.
   1. Itemize each material and quantity in 8-1/2 by 11-inch paper.

C. Label each items for easy identification.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting IOR’s inspection for certification of Substantial Completion for entire Project or for a portion of Project:
      a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Remove snow and ice to provide safe access to building.

f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. 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.
    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

3.2 DSA PROJECT CLOSEOUT AND FINAL CERTIFICATION OF CONSTRUCTION

A. Verified Reports: Per Title 24 Part1, Section 4-336.

B. Final Certificate of Construction: Per Title 24 Part1, Section 4-339.

C. Duties of Contractor: Per Title 24 Part1, Section 4-343.

3.3 FORMS

A. Electronic versions of attached forms will be provided upon request.
    1. Punch-List Form.

END OF SECTION 017700

PUNCH-LIST FORM

☐ Preliminary Punch-List.
☐ Final Punch-List.

Project:	From:
To:	Date:

Item No.	Room No.	Area	Description	Completion Date	A/E Verification

End of Punch-List Form

SECTION 017823 - OPERATION AND MAINTENANCE DATA

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 for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Maintenance manuals for the care and maintenance of products, materials, and finishes.

B. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Other Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return 1 copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.

3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Water leak.
   5. Power failure.
   6. Water outage.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard printed maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
   1. Do not use original Project Record Documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

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 for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for general closeout procedures.
   2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Other Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit 1 set of marked-up Record Prints.

B. Record Specifications: Submit 1 copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit 1 copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
   1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "PROJECT RECORD DRAWINGS."
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

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

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
   4. Assemble in single binder with table of contents.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

3.2 FORMS

A. Electronic versions of attached forms will be provided upon request.
   1. Record Product Data Form.

END OF SECTION 017839

RECORD PRODUCT DATA FORM

Record Product Data is due no later than 10 calendar days after the date of Substantial Completion. Photocopy for continuation sheets. List products in order by specification section numbers.

Project Name:	From:
To:	Date:

Spec Section		Originally Specified		Actually Installed	
No.	**Title**	**Model**	**Manufacturer**	**Model**	**Manufacturer**

End of Record Product Data Form

SECTION 017900 - DEMONSTRATION AND TRAINING

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 for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for requirements for preinstruction conferences.
   2. Other Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Instruction Program: Submit 2 copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. At completion of training, submit 1 complete training manual(s) for Owner's use.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.

E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

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 the following:
   1. Demolition and removal of selected portions of building or structure.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

A. Qualification Data: For demolition firm.

B. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
   6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
   7. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Pre-demolition Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Storage or sale of removed items or materials on-site is not permitted.

B. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
   1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
      a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
   5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated. Patch and repair with similar materials.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts. Patch and repair with similar materials.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
1. Patch and repair with similar materials.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Division 1 Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

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

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Concrete Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control**,** concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, concrete repair procedures, and concrete protection.

1.5 SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each mix design to be prepared by a California Registered Civil Engineer. Submit to Testing Laboratory and Architect for review.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Qualification Data: For installer, manufacturer, testing agency.

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

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Floor and slab treatments.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. 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.

C. Perform work in accordance with ACI 301.

D. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction**,** qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 REGULATORY REQUIREMENTS

A. Conform to CBC – California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

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 302.
3. ACI 305.
4. ACI 306.
5. ACI 309.
6. ACI 318.
7. ACI 117.
8. ACI 360.

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.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

3. Overlaid Finnish birch plywood.

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.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.3 STEEL REINFORCEMENT

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

B. Reinforcing bars to be welded: Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M.

D. Deformed-Steel Wire: ASTM A 1064/A 1064M.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780/A 780M.

C. 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," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type 1 or II, grey color.
2. Fly Ash: ASTM C 618 , Class F.

C. Normal-Weight Aggregates: ASTM C-33 .

1. Maximum Coarse-Aggregate Size: 1 inch, nominal.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. 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.
7. Shrinkage Reducing Admixture: ASTM C 494, Type S.

F. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
1. Color: As selected by Architect from manufacturer's full range.

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.8 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

C. Emery Dry-Shake Floor Hardener: factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

D. Metallic Dry-Shake Floor Hardener: factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

E. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.9 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.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or, ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 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.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 15 percent.

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

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. General Use: Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum W/C Ratio: 0.55.
3. Slump Limit: 4 inches plus or minus 1 inch.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, 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. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

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

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

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

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

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

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

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

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

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

3.2 EMBEDDED ITEM INSTALLATION

1. Install anchor rods and other embedded items, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT INSTALLATION

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

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

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

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

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

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

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
2. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness or as indicated on the drawings.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

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

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

C. 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. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

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

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

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

3.8 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. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and, to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish.

D. 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 indicated, exposed to view or, to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

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

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

3. For supported equipment, install anchor bolts that extend through concrete base and anchor into structural concrete substrate.
4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 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. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. 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 with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

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

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

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 unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

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

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

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

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

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

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

3.13 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M and CBC Chapter 19A shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. 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.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155.

3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   2. Miscellaneous framing supports.
   3. Miscellaneous steel trim.
   4. Mechanical equipment enclosures.

B. Related Sections include the following:
   1. Division 9 Section “Painting” for field painting.

1.3 DEFINITIONS

A. Exterior: Defined as the following:
   1. Areas, locations, and surfaces that are unprotected, or exposed to environmental elements.
   2. Areas, locations and surfaces within uncontrolled environments.
   3. Areas, locations and surfaces of unconditioned spaces, including belowgrade/underground, partially-exposed, or “covered” parking areas.

1.4 PERFORMANCE REQUIREMENTS

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

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: For items specified.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Provide templates for anchors and bolts specified for installation under other Sections.

1.6 QUALITY ASSURANCE

A. Treads, Risers, and Nosings: CBC Section 11B-504.
   1. Interior stairs shall have the upper approach and lower tread marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
   2. The stripe providing clear visual contrast shall be a minimum of 2” wide to a maximum of 4” wide placed parallel to, and not more than 1” from, the nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
   3. The radius of curvature at the leading edge of the tread shall be no greater than ½”. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. The maximum angle for a riser to slope under the tread shall be 30 degrees from vertical. Nosings shall extend 1-1/4" maximum over the tread below.
   4. Treads shall be 11” deep minimum. Risers shall be 7” high maximum and 4” high minimum. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.

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

1.7 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal fabrications that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

2.2 FERROUS METALS

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

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

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

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

E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

F. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-3.
1. Size of Channels: 1-5/8 by 1-5/8 inches or as indicated.
2. Material: Galvanized steel complying with ASTM A 653, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.

2.3 FASTENERS

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

B. Anchor Bolts: ASTM F 1554, Grade 36.
1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

2.4 MISCELLANEOUS MATERIALS

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

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
   1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Surface Preparation: SSPC-SP2 Hand Tool Clean and /or SSPC-SP3 Power Tool Clean.

D. Organic Zinc-Rich Primer: Complying with SSPC-Paint 20 and compatible with topcoat, and meets AISC slip coefficient as a Class B Coating.
   1. Surface Preparation: SSPC-SP6 Commercial Blast Clean.
   2. Products:
      a. Tnemec Company, Inc.; Tneme-Zinc 90-97, 2.5 to 3.5 mils DFT (Basis of Design)
      b. Other manufacturers listed in Division 9 Section “High Performance Coatings”.
      c. Or equal.

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

2.5 FABRICATION, GENERAL

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

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

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

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

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

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

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

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

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

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

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

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Field painted exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated.

2.9 MECHANICAL EQUIPMENT ENCLOSURES

A. HVAC security fencing/cages by Cageitup.com or equal.
   1. Expanded Metal fences: Fabricate to dimensions and details shown, with welded joints ground smooth and flush. Hot-dipped galvanized at exterior locations. Fabricate and install to comply with requirements of ASTM E985 for structural performance based on testing performed in accordance with ASTM E894 and E935.
      a. Fencing sections 3/4" #9 expanded metal welded to tube frame.
      b. Fence Frame, including top frame: 2" x 14 ga. square tube.
      c. Ceiling/top: Same as fencing.
      d. 5" x 11ga square tube, 1 1/2" x 1/4" flat iron.
      e. Hinges: 4x4 heavy duty weld-on butt hinges as supplied by Jansen Ornamental Supply Company. Use model 1850 4x4PL, 7 gauge with 3/4" hinge gap, non-swaged, zinc plated.
      f. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
      g. When anchoring to concrete slab, posts will have 6" x 6" x 1/4" mounting plate with (4) 7/16" holes to accept 3/8" wedge anchors.
      h. Provide galvanized inserts for concrete paving.

2.10 FINISHES, GENERAL

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

B. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123, for galvanizing steel and iron products.
   2. ASTM A 153, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Field Finish: Comply with Division 9 Section “Painting” for field painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for sectional doors securely to and rigidly brace from building structure.

3.3 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 7 Section "Joint Sealants" to provide a watertight installation.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

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

END OF SECTION 055000

SECTION 055134 - ALUMINUM LADDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Vertical ladders.

B. Related Sections include the following:
   1. Division 7 Section “Roof Accessories” for roof hatch and ladder safety post.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product.

B. Shop Drawings:
   1. Detail fabrication and erection of each ladder indicated. Include plans, elevations, sections, and details of metal fabrications and their connections.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. Provide reaction loads for each hanger and bracket.

C. Qualification Data: Refer to Quality Assurance provisions for submittal requirements evidencing experience, certifications and resources.

D. Verification Samples: For each finish specified, two samples, minimum size 6 inches square, represent actual product color.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in producing aluminum metal ladders similar to those indicated for this Project.

B. Record of successful in-service performance.

C. Sufficient production capacity to produce required units.

D. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum ladders that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Ladders: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. O’Keeffe’s Inc. (Basis of Design)
      a. Vertical Ladders: Model 501.
   2. Royalite.
   3. Alaco.
   4. Precision.
   5. Cotterman.
   6. ACL.
   7. Or equal.

2.2 MATERIALS

A. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.

B. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.

C. Fasteners: As recommended by ladder manufacturer.

2.3 VERTICAL LADDERS

A. Product: Model 501 Heavy Duty Tubular Rails Fixed Access Aluminum Ladder by O'Keeffe's Inc. or equal.
   1. Rungs: Not less than 1-1/4 inches in section and 18-3/8 inches long, formed from tubular aluminum extrusions. Squared and deeply serrated on all sides.
   2. Rungs shall withstand a 1,500 pound load without deformation or failure.
   3. Heavy Duty Tubular Side Rails: Assembled from two interlocking aluminum extrusions no less than 1/8 inch wall thickness by 3 inches wide. Construction shall be self-locking

stainless steel fasteners, full penetration TIG welds and clean, smooth and burr-free surfaces. Channel side rails are not acceptable.

2.4 ALUMINUM FINISHES

A. Mill finish. As extruded.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor securely using fasteners specified by manufacturer or others of equivalent or greater strength and corrosion resistance.

END OF SECTION 055134

SECTION 061000 - ROUGH CARPENTRY

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. Framing with dimension lumber.

2. Roof & Wall Sheathing.
3. Rooftop equipment bases and support curbs.
4. Wood blocking, cants, and nailers.
5. Wood furring and grounds.
6. Wood sleepers.
7. Utility shelving.
8. Plywood backing panels.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. 2x and 3x joists, rafters, and sub-purlins:
1. Species: Douglas Fir Larch.
2. Grade: No. 2.

B. 2x and 3x studs, plates, and blocking :
1. Species: Douglas Fir Larch.
2. Grade: No. 2.

C. 4x and 6x posts :
1. Species: Douglas Fir Larch.
2. Grade: No. 1.

D. 4x and 6x beams, purlins, headers and blocking :
1. Species: Douglas Fir Larch.
2. Grade: No. 1.

E. Wood, cants, furring, grounds, sleepers and other non-structural items:
1. Species: Douglas Fir Larch.
2. Grade: Construction.

2.4 MISCELLANEOUS LUMBER

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

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Utility Shelving: Lumber with 19 percent maximum moisture content of any of the following the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine or southern pine; No. 1 grade; SPIB.
3. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
1. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
2. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
3. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 STRUCTURAL ROOF & WALL SHEATHING

A. Roof Sheathing: APA Structural 1, Grade C-D, Exposure 1, minimum 5 ply construction, complying to Product Standard PS 1-95.

B. Wall Sheathing: APA Structural 1, Grade C-D, Exposure 1, minimum 5 ply construction, complying to Product Standard PS 1-95.

2.7 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.8 METAL FRAMING ANCHORS

A. Metal framing anchors shall be manufactured by Simpson Strong-Tie and shall be of type indicated.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction..

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Install shear wall panels to comply with manufacturer's written instructions.

F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

H. Do not splice structural members between supports unless otherwise indicated.

I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

O. Use steel common nails. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND OTHER NON-STRUCTURAL FRAMING INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs. Fasten plates to supporting construction unless otherwise indicated. Construct as indicated on the drawings.

3.5 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

B. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.6 PROTECTION

A. Protect rough carpentry from weather.

END OF SECTION 061000

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Plywood sheathing.

B. Related Sections:
   1. Division 9 Section “Portland Cement Plaster” for weather resistive barriers.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheathing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
2. Warranty Period: 5 years.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Plywood sheathing: Comply with structural Drawings.

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 A 153.

B. Power-Driven Fasteners: NES NER-272.

2.3 MISCELLANEOUS MATERIALS

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. 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.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Plastic-laminate cabinets.
   2. Plastic-laminate countertops.
   3. Solid-surfacing-material countertops.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Cabinet and Drawer Hardware:
      a. Operable parts for all accessible casework shall comply with CBC Section 11B-309.

1.5 SUBMITTALS

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

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   2. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
   3. Apply WI-certified compliance label to first page of Shop Drawings and follow Section 1, “Guidelines for Architectural Millwork Shop Drawing”.

C. Samples for Verification:
   1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.

2. Solid-surfacing materials, 6 inches square.
3. Corner pieces as follows:
   a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.
   a. Hardware samples will be returned up on approval.

D. Product Certificates: For each type of product, signed by product manufacturer.

E. Woodwork Quality Standard Compliance Certificates for Product and Installation: WI-certified compliance certificates confirming conformance with Certified Compliance Program (CCP).

F. Qualification Data: For Installer and fabricator.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

C. Quality Standard: Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. Before delivery to job-site, Millwork supplier:
   a. Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
   b. Non-Licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
2. Each elevation of casework and each countertop shall bear certified compliance label.
3. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.

D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

E. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

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

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of interior architectural woodwork that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. High-Pressure Decorative Laminate:
1. Formica Corporation. (Basis of Design)
2. Pionite.
3. Wilsonart International; Div. of Premark International, Inc.
4. Nevamar Company, LLC; Decorative Products Div.
5. Arpa.
6. Abet Laminati.
7. REHAU.
8. Or equal.

B. Solid Surfacing Materials:
1. Corian by E. I. du Pont de Nemours and Company. (Basis of Design)
2. Formica Corporation.
3. LG Hausys.
4. Nevamar Company, LLC; Decorative Products Div.
5. Wilsonart International; Div. of Premark International, Inc.
6. Or equal.

C. Medium-Density Fiberboard:
1. Medex, Medex NC, Medite II, or Arreis SDF by SierraPine Ltd.
2. Weyerhaeuser Company; Premier Plus by Weyerhaeuser.
3. Or equal.

D. Particleboard:
1. Rodman Industries, Inc.
2. Acadia Board Company.
3. PrimeBoard, Inc.
4. Or equal.

2.2 MATERIALS

A. General: Provide materials that comply with requirements of WI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Core and Substrates: Comply with the following:
1. Backs of cabinets, book cases, etc.
a. Hardboard: AHA A135.4.
2. Plastic-laminates:
a. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
3. Wood Veneer-Faced Panel Products, melamine, and shelving:
a. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.

C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
   1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.

D. High-Pressure Decorative Laminate (HPDL): NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
   1. Colors: As indicated on Drawings.

E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
   1. Type: Standard type, unless Special Purpose type is indicated.

2.3 CABINET HARDWARE AND ACCESSORIES

A. Adjustable Shelf Pilaster Standards: Side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
   1. 23 gauge high strength steel.
   2. 39/64" wide x 11/64" deep.
   3. BHMA Grade 1 approved.

B. Shelf Support Pins:
   1. Stainless steel.
   2. Pin diameter for 5 mm hole (approx 13/64 inch).

C. Grommets: Plastic, 2 inch diameter, locations as indicated. If locations are not indicated, as selected by Architect during shop drawing review or a minimum of 1 Grommet per 3 linear feet of countertop.
   1. Doug Mockett or equal.

D. Drawer and Door Pulls: For all, including accessible casework.
   1. "U" shaped wire pull, aluminum with satin finish, 4 inch centers.

E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish to key with door hardware. All doors and drawers to be lockable.

F. Hinges: European fully concealed hinges, ANSI-BHMA Grade 2, “self-closing”, 120 degree opening. Blum Clip Top, Grass Nexus or equal.
   1. Opening angle: 120 degrees per the NAAWS.

G. Drawer Slides: BHMA A156.9, B05091.
   1. Heavy Duty (Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect 7 days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

E. Drawer bottoms to be fully let-in, glued and blocked. Joinery must be lapped and mitered, no butt joints.

2.6 PLASTIC-LAMINATE CABINETS

A. WI Construction Style: Style A, Frameless.

B. WI Construction Type: Type I, multiple self-supporting units rigidly joined together.

C. WI Door and Drawer Front Style: Flush overlay.

D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
1. Horizontal Surfaces Other Than Tops: Grade HGS, 0.048 inches (1.2 mm) thick.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS, 0.048 inches (1.2 mm) thick.
4. Edges: Self-edge banded.

E. Semi-Exposed Surfaces: Any of one of following.
1. Low pressure decorative polyester overlay.
2. Low pressure decorative melamine overlay.
3. HPL cabinet liner.
4. Solid Phenolic core (SPC).
5. Vinyl at cabinet backs and drawer bottoms only.

F. Concealed Surfaces: Any of one of following.
1. Solid Wood or Plywood: Any hardwood or softwood species, with no defects affecting strength or utility. Hardwood and softwood lumber kiln dried to 7 and 10 percent moisture content, respectively.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Medium-Density Fiberboard: ANSI A208.2.
4. Solid Phenolic core (SPC).

2.7 PLASTIC-LAMINATE COUNTERTOPS

A. High-Pressure Decorative Laminate Grade: HGS, 0.048 inches (1.2 mm) thick.

B. Provide Exterior grade plywood at wet locations and comply with following:
1. No seams shall occur within 18 inches of sink cut-outs.
2. Sink cut-outs shall be coated with opaque sealer.
3. Back splash shall coordinate with size of soap and paper tower dispensers for solid attachment.
4. Corners of tops shall be cut at 45 degrees if projecting or in pathway.

C. Edge Banding: Colored PVC tape, to match plastic laminate surface.

D. Laminate Substrates: Medium-density fiber board (MDF). Do not use plywood.

E. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

F. Waterfall edge with backsplash.

G. Marine grade plywood within 4 foot of sinks and at wet areas.

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Solid-Surfacing-Material Thickness: 3/4 inch.

B. Edge: 1-1/2 inch thick eased edge.

C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

D. Integral Cove: Provide shop fabricated integrally molded coves at back and ends where against walls or other vertical surfaces, with 3/8” radius between top and splash.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
4. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 068200 - FIBER REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fiber reinforced plastic panel system for adhesive mounting.
   2. Moldings, adhesive, and joint sealants.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Selection Samples: For each finish specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

C. Maintenance Instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fiber reinforce plastic panels that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fiber Reinforced Plastic Panels: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Formica. (Basis of Design)
   2. Marlite.
   3. Nudo.
   4. Crane Composites (formerly Kemlite).
   5. Glasteel.
   6. Or equal.

2.2 PANEL SYSTEM

A. Plastic Panel System: Factory finished panels, trim, sealant, and accessories.

B. Product: HardStop Decorative Protection Panels by Formica or equal.
   1. Panel Core Material: Treated fiberglass core.
   2. Laminate Grade:
      a. Grade H1, 0.0677 Inches - 0.0827 Inches.
   3. Tested Data:
      a. ANSI / NEMA LD-3: High Pressure Decorative Laminates.
      b. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials. Class 1/A Fire-rated (UL723/ASTM E-84).
         1) Flame-Spread Index: 25 or less.
         2) Smoke-Developed Index: 450 or less.
      c. GreenGuard Gold Indoor Air Quality Certified®.
      d. SEFA 8.1 approved.
      e. ASTM G 22 Bacterial Growth Resistance.
   4. Laminate Finish: As indicated on Drawings.
   5. Laminate Color(s): As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Take panels out of cartons and allow to acclimatize to room conditions for at least 48 hours prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Clean surfaces thoroughly prior to installation.

D. Protect existing surfaces from damage due to installation.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Use the adhesives recommended by the panel manufacturer unless prohibited by local regulations; obtain manufacturer's approval of alternative adhesives.

C. Install continuous bead of silicone sealant in each joint and trim groove and between trim and adjacent construction, maintaining 1/8 inch expansion space.

D. Avoid contamination of panel faces with adhesives, solvents, or cleaners; clean as necessary and replace if not possible to repair to original condition.

E. Protect installed products until completion of project.

F. Touch-up, repair or replace damaged products after Substantial Completion.

END OF SECTION 068200

SECTION 071909 - CONCRETE MOISTURE AND ALKALINITY TESTING

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 for independent testing and inspection requirements for concrete moisture and alkalinity.

B. Related Sections include the following:
   1. Division 7 Section “Concrete Moisture and Alkalinity Barrier” for concrete sealers to reduce moisture and alkalinity level when testing fails.

1.3 SUBMITTALS

A. Independent testing agency qualifications: Past 4 year history of testing of comparable project size and scope.

B. Product data: Moisture test kit.

C. Testing Results: Provide interior temperature, humidity, moisture vapor and alkalinity results for testing period.
   1. Alkalinity and Adhesion Test Report.
   2. Moisture Test Report.

D. Locations Map: Provide each testing result documented on a locations map. Map may be finish floor plan by Architect or similar representation.

E. Record Submittals: Testing reports and locations map.

1.4 SCHEDULING

A. Site Meeting: Testing Agency, Owner, Architect and Contractor shall meet 30 days prior to flooring installation to discuss testing requirements, specifications and locations prior to testing.

PART 2 - PRODUCTS

2.1 MOISTURE TESTING

A. Test Method: ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
   1. ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride is NOT acceptable method.

B. The In-Situ Method:
   1. In-situ probes deepen concrete moisture measurement. For decades, builders used (and some still do) the anhydrous calcium chloride test for concrete moisture vapor emissions rate (MVER). The MVER is defined as the rate of water vapor emissions from the surface of concrete and is determined with the use of a desiccant material sealed to the slab surface for a specified time period, then measured. It has been believed that the change in the desiccant weight could be translated into a moisture ratio for the concrete beneath.
   2. In-situ concrete moisture testing places sensors, or probes, inside the slab itself. As concrete dries, moisture migrates from the bottom of the slab to the surface where it can evaporate away. Logically then, moisture levels at the bottom of a slab will read higher from those at the surface. In-situ probes provide relative humidity (RH) measurements at 40% of the slab's depth*, a position proven to more accurately portray the final RH levels of the slab if it were to be sealed at that point in time and the slab moisture allowed to fully equilibrate.

C. Acceptable Testing Devices for ASTM F2170 Test:
   1. Wagner Meters Rapid RH® system by Wagner.
   2. Protimeter by T Equipment.
   3. Relative Humidity Meter system by American Moisture Test.
   4. Or equal.

2.2 ALKALINITY TESTING

A. Alkalinity Test, ASTM F 710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
   1. Digital wide range 1–14 pH meter.
   2. Waterproof flat tip.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site: Weatherproofed, doors installed and windows secured. Do not start testing process when site has standing water, surface contaminates, exposed to exterior conditions or concrete installation is less than 90 days of age.

3.2 PREPARATION

A. Clean concrete substrates of adhesives residue, paint, curing, sealing, floor coverings a minimum of 24 hours prior to installation of testing equipment.

B. Temperature & Humidity: Maintain site at the temperature and humidity conditions to those anticipated during normal occupancy and maintain these conditions minimum of 7 days (exceed ASTM F1869 requirements) prior and during testing period.

C. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with testing results.

3.3 MOISTURE TESTING

A. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F2170.

B. Floor shall have reading of 95% or less per ASTM F2170; unless finish flooring product require better value.

3.4 ALKALINITY TESTING

A. Test: Perform pH testing per ASTM F710.

B. pH range between 8 and 10; unless finish flooring product require better value.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage and pay for qualified independent testing agency specified to perform the following field tests and inspections and prepare test reports:
   1. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
   2. Testing agency shall verify thickness of coatings during traffic coating application.
   3. If test results show coating materials do not comply with requirements, remove noncomplying materials, prepare surfaces, and reapply coatings.

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

END OF SECTION 071909

SECTION 071910 - CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes concrete sealer.

1.3 SYSTEM DESCRIPTION

A. Ground and Floor Surfaces: Slip resistant per CBC 11B-302.1.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include manufacturer's printed statement of VOC content.

B. Samples: For each type of sealer and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

C. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
   1. Ambient temperature is above 40 deg F.
   2. Concrete surfaces and mortar have cured for more than 28 days.
   3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
   4. Rain or snow is not predicted within 24 hours.
   5. Application proceeds more than 24 hours after surfaces have been wet.
   6. Substrate is not frozen, or surface temperature is above 40 deg F.
   7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Patching compound, cementitious, thin patching and skim-coating material, designed for reducing surface defects on interior floors. : Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Degussa.
   2. ChemMasters.
   3. Or equal.

B. Concrete Clear Sealer for protecting antiqued, imprinted, chemically stained, exposed-aggregate, and colored or uncolored concrete hardscapes and floors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Scofield. (Basis of Design)
   2. Prosoco.
   3. Degussa.
   4. ChemMasters.
   5. Rain Guard.
   6. Or equal.

2.2 PATCHING COMPOUND

A. Patching compound, cementitious, thin patching and skim-coating material, designed for reducing surface defects on interior floors.

1. Composition and Materials:
   a. Complex, precisely engineered, polymer-modified, cementitious, thin patching material produced by a proprietary manufacturing and intergrinding process.
   b. Designed for ease of mixing and installation, superior adhesion without priming, and rapid strength gain, it is a single-component, non-gypsum-based, powdered material containing no sand or calcium chloride.

2.3 SEALER

A. Product: Cementone by Scofield.
   1. Concrete Clear Sealer for protecting antiqued, imprinted, chemically stained, exposed-aggregate, and colored or uncolored concrete hardscapes and floors.
   2. Waterborne, modified acrylic emulsion.
   3. Optimized for surface penetration, leveling ability, and ease of application by airless sprayer without thinning.
   4. Some separation occurs during storage that is easily reincorporated when stirred before using.
   5. Cleanup with soap and water.

PART 3 - EXECUTION

3.1 PREPARATION

A. New Concrete:
   1. Newly placed concrete shall be sufficiently cured to allow concrete to become reactive, minimum 28 days.
   2. Do not use liquid curing materials. Cure concrete flatwork with new, unwrinkled, non-staining, high quality curing paper. Do not overlap curing paper.
   3. Surfaces shall be cured using the same method and different sections (pours) chemically stained when the concrete is the same age.
   4. Immediately prior to chemically staining, thoroughly clean the concrete. Sweep surfaces, the pressure wash or scrub using a rotary floor machine. Use suitable, high-quality commercial detergents to facilitate cleaning. Rinse surfaces after cleaning until rinse water is completely clean. Allow floor to dry completely prior to application of floor stain.
   5. Concrete surfaces must be uniformly slip-resistant and profiled to meet a Concrete Surface Preparation (CSP) profile of 1-2 per ICRI guidelines.
   6. Some concrete may require abrading to open the surface and make it sufficiently penetrable. In these instances the concrete surface must be sanded using an 60-80 mesh-sanding screen or a grit brush. After sanding, all residue must be removed by power vacuuming. The surface should then be pressure washed or scrubbed using a rotary floor machine.
   7. For preparation, the sandblaster should be capable of producing a light, uniform sandblast and be equipped with a dust collector.
   8. For preparation, the pressure washer should be equipped with a fan tip and have a minimum pressure capability of 4000 psi. Hot water capability may facilitate cleaning of existing concrete.

9. Acid washing may be required when the above surface preparation does not yield adequate penetration or if there are excessive alkali deposits or surface discoloration. The reacted residue must be abraded using a low-speed floor machine equipped with a 60 mesh screen or a grit brush and then thoroughly rinsed until the rinse water is clear and free of solids, a minimum of two times. After rinsing, neutralize any remaining acid residue by washing with a solution of baking soda (sodium bicarbonate) and water. (Test pH of floor should be 7 or higher.)

B. Existing Concrete:
1. Clean concrete surfaces so that surfaces are completely penetrable before receiving the initial application of chemical stain. Test surfaces to receive stain by spotting with water. Water should immediately darken the substrate and be readily absorbed. If water beads and does not penetrate or only penetrates in some areas, additional surface preparation and testing shall be performed.
2. Cleaning method used depends on the condition of the concrete surface. To remove dirt and other contaminates, detergents and other commercial grade cleaners should be considered and tested.
3. Rinse concrete substrates until rinse water is completely clean.
4. For preparation of interior floors, the rotary floor machine should be heavy duty and operate at approximately 175 rpm. With a 60-80 mesh-sanding screen or a grit brush, remove all contaminates and weak cement paste from the surface. This will also open the surface to allow the chemical stain to penetrate.
5. Acid washing may also be required. (Refer to New Concrete Preparation.)

C. Scoring: Score decorative jointing in concrete surfaces 1/8-inch (3.2 mm) deep with diamond blades. Rinse until water is completely clean.

3.2 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 APPLICATION OF SEALER

A. Concrete substrate shall be completely dry.

B. Sealer shall be produced by the water-based reactive stain manufacturer.

C. After the final stain application has dried sufficiently, normally 8-24 hours at 75 F and 50 percent relative humidity, remove all contaminates from the surface by dry mopping if required.

D. Apply sealer according to manufacturer’s written instructions at a rate of 300 to 500 square feet per gallon per coat. Two coats are required.

E. Maintain a wet edge at all times.

F. Allow sealer to completely dry before applying additional coats.

G. Apply second coat of sealer at 90 degrees to the direction of the first coat using the same application method and rates.

H. Seal horizontal joints in areas subject to pedestrian or vehicular traffic.

3.4 CLEANING

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

END OF SECTION 071910

SECTION 071920 - CONCRETE MOISTURE AND ALKALINITY BARRIER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:
   1. Concrete moisture and alkalinity barrier when moisture or alkalinity test fails.

B. Related Sections include the following:
   1. Division 7 Section “Concrete Moisture and Alkalinity Testing” for independent moisture and alkalinity testing prior to installation of flooring materials.

1.3 PERFORMANCE REQUIREMENTS

A. Ground and Floor Surfaces: Slip resistant per CBC 11B-302.1.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include manufacturer's printed statement of VOC content.

B. Samples: For each type of barrier and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

C. Manufacturer Certificates: Signed by manufacturers certifying that barrier comply with requirements.

D. Qualification Data: For Installer.

E. Product Test Reports: Independent third party testing results:
   1. ASTM E 96 Water Vapor Transmission: up to 95% Vapor Reduction
   2. ASTM D 4541 Concrete Adhesion: 500psi or concrete cohesive failure
   3. ASTM D 1308 Chemical Resistance: 100% resistant to acid and alkali

F. Field Quality Control Documents: Post installation testing by independent testing agency per ASTM F1869, ASTM D 4541.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

A. Extended Warranty Period: Barrier warranty for 15 years covering performance, concrete adhesion, moisture or alkalinity damage to barrier and installed floor coverings. In the event of barrier failure, manufacturer shall cover labor and material cost to replace moisture or alkalinity damaged flooring or coatings, reapply barrier, adhesives, patching compounds and installation accessories.
   1. Moisture Vapor Reduction: No upper performance limitations.
   2. Alkalinity Control: No upper performance limitations.
   3. Manufacturing defects warranties are not acceptable.

B. Warranty shall not exclude ACI documents, dew point, concrete salts, admixtures, resin and silicate surfaces treatments. Installations on slab surfaces deems acceptance of on site conditions. Barrier manufacturer is responsible for complete review of concrete mix designs, admixtures, sub slab vapor barrier installed and curing methods for written acceptance prior to installations.

C. Installer: Submit 15 year warranty covering installation defects and improper installations on workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Concrete Moisture and Alkalinity Barrier: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. VAP-1 2000 FS by Koster. (Basis of Design)
   2. Vapor-Guard DC by Advance Moisture Control.
   3. MES 100 by Floor Seal Technology Inc.
   4. Or equal.

2.2 CONCRETE MOISTURE AND ALKALINITY BARRIER

A. Product: VAP I 2000 FS by Koster or equal.
   1. Fast-setting, one-coat, membrane-forming, moisture vapor control system consisting of a unique combination of epoxy resins and other compounds formulated to prevent floor covering failures on concrete slabs with elevated levels of moisture.
   2. Meets or exceeds the performance requirements in ASTM F3010-13 Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.
   3. Has no upper limit for water vapor emission from concrete floor slabs. It can be applied to concrete slabs with relative humidity up to 100% RH and it provides protection from sustained exposure to pH 14.
   4. Low permeance of 0.047 perms, moisture blocker for virtually all types of flooring, including low permeance flooring such as sheet goods and rubber tile.
   5. Compliant with all state and federal VOC regulations, having VOC content of 0 g/L, which allows installation in sensitive areas such as hospitals, schools, and grocery stores.

B. Concrete Topcoat: Cement based self-leveling underlayment product acceptable to sealant manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to barrier manufacturer's written instructions, to ensure that surface is dry enough.
   1. Shot blast surface to allow maximum penetration and adhesion. Grind near walls and edges.

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

C. Coordination with Sealants: Do not apply barrier until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
   1. Barrier work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

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

3.2 APPLICATION

A. Barrier: Apply by squeegee and roller application methods to saturate entire surface. Spread rates shall produce results of up to 95% moisture reduction per ASTM E 96 and post installation testing rate specified.

B. Roller and squeegee methods to saturate concrete porosity. Final surfaces shall be light reflective white.

C. Joint and Crack Treatment: Apply barrier directly over cracks, holes, and slab imperfections for maximum flexibility, moisture vapor and alkalinity control.

D. Cement Topcoat: As required for applications under resilient flooring for sealants installed after curing of concrete.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. Conduct moisture-alkalinity test by an independent testing company prior to resilient flooring and carpet installation.

3.4 CLEANING

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

END OF SECTION 071920

SECTION 072100 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Concealed thermal and sound insulation.

B. Related Sections include the following:
   1. Division 9 Section "Gypsum Board" for installation in metal-framed assemblies of insulation specified by referencing this Section.

1.3 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 SUBMITTALS

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

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Surface-Burning Characteristics: ASTM E 84.
   2. Fire-Resistance Ratings: ASTM E 119.
   3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of building insulation that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass-Fiber Batt/Blanket Thermal and Sound Insulation: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Johns Manville (JM). (Basis of Design)
   2. CertainTeed Corporation.
   3. Guardian Fiberglass, Inc.
   4. Knauf Fiber Glass.
   5. Owens Corning.
   6. Lamtec.
   7. Or equal.

B. Extruded Polystyrene Foam: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Styrofoam Z-Mate by Dow. (Basis of Design)
   2. Atlas.
   3. DiversiFoam Products.
   4. Owens Corning.
   5. Pactiv Building Products Division.
   6. Or equal.

2.2 GLASS-FIBER BATT/BLANKET INSULATION

A. Unfaced, Glass-Fiber Batt/Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics. Glass-fiber bonded with acrylic thermosetting binder.
   1. For walls and partitions: Unfaced Batts.

2. Formaldehyde-free, Unfaced Batts by JM or equal.

B. Faced, Glass-Fiber Batt/Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft vapor-retarder membrane on 1 face.
1. For ceilings under decks: FSK-25 Faced Batts with 2 inch tabs or Panel Deck FSK-25 Faced Batts with 5 inch tabs.
2. Formaldehyde-free, FSK-25 Faced Batts by JM or equal.

C. Thermal Rating: R values as indicated on Drawings.
1. 2x6 walls: R-21.
2. 2x8 walls: R-25.

2.3 EXTRUDED POLYSTYRENE FOAM (RIGID INSULATION)

A. Extruded Polystyrene Foam: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively.
1. 1.5 inch thick board: R-7.5.
2. R-rating: Built-up board to comply with R-rating indicated on Drawing.

2.4 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inches wide.

B. Nails or Staples: Steel wire; electroplated, or galvanized; type and size to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

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

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated 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. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, 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.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

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. Seal joints between foam-plastic insulation 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. Install insulation 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 cavity, 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.
   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.
   6. For wood-framed construction, install mineral-fiber blankets according to ASTM C 1320 and as follows:

D. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces for sound deadening, sound absorption, thermal protection, or air-infiltration reduction. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.5 INSTALLATION OF INSULATION IN CEILINGS

A. Install insulation to achieve thermal indicated attached to roof or floor deck from below.

B. Insulation to roof or floor deck: Install by one of following methods.
   1. Staple insulation to sides of joists or trusses at 4 inches o.c. through bent down flanges of vapor barrier in such manner that air leaks between insulation and joints are minimized.
   2. Fasten insulation anchors to deck substrates with insulation anchor according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

3.6 PROTECTION

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

END OF SECTION 072100

SECTION 075500
MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of the roof system down to the wood substrate. Repair all dry rot in kind. Include 7% dry rot contingency in base bid. Loose lay a Rosin sheet and mechanically fasten HPR Glasbase. Install a Hot Applied 2-Ply Asphalt Roofing (StressPly). With White Star and Viking Lucas Fire Star gravel surfacing.

B. New R-Mer Edge Gutter and edge system, 22 g, Tie In new leaders to existing schedule 40 downspouts. Downspouts snaked and cleared.

C. R-Mer Edge Fascia perimeter which meets ANSI/SPRI ES-1 and Roof Penetration Flashings.

D. Prime and Paint all exposed dry rot replacement and fascia gutters (Russo) to match existing District Color Scheme. District will provide paint color number to purchase and match existing.

1.2 RELATED SECTIONS

A. None.

1.3 REFERENCES

A. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

B. ASTM D 312 - Standard Specification for Asphalt used in Roofing.

C. ASTM D 451 - Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.

D. ASTM D 6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

E. ASTM D 6163 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.

F. ASTM D 6164 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

G. ASTM D 6757 - Standard Specification for Underlayment Felt Containing Inorganic Fibers Used in Steep-Slope Roofing.

H. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings

I. Factory Mutual Research (FM): Roof Assembly Classifications.

J. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

K. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

L. Underwriters Laboratories, Inc. (UL): Fire Hazard Classifications.

M. Warnock Hersey (WH): Fire Hazard Classifications.

N. ANSI-SPRI ES-1 Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.

O. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures

P. UL - Fire Resistance Directory.

Q. FM Approvals - Roof Coverings and/or RoofNav assembly database.

R. California Title 24 Energy Efficient Standards.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Exterior Fire Test Exposure: Roof system shall achieve a UL, FM or WH Class rating for roof slopes indicated on the Drawings as follows:
1. Factory Mutual Class A Rating.
2. Underwriters Laboratory Class A Rating.
3. Warnock Hersey Class A Rating.

C. Energy Star: Roof System shall comply with the initial and aged reflectivity required by the U.S. Federal Government's Energy Star program.

D. LEED: Roof system shall meet the reflectivity and emissivity criteria to qualify for one point under the LEED credit category, Credit 7.2, Landscape & Exterior Design to Reduce Heat Island - Roof.

E. Roof System membranes containing recycled or bio-based materials shall be third party certified through UL Environment.

F. Roof system shall have been tested in compliance with the following codes and test requirements:
1. Cool Roof Rating Council:
   a. CRRC 0700-0027
2. Underwriters Laboratories:
   a. Certification
3. Warnock Hersey
   a. ITS Directory of Listed Products
4. FM Approvals:
   a. RoofNav Website

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation instructions.

C. Shop Drawings: Submit shop drawings including installation details of roofing, flashing, fastening, insulation and vapor barrier, including notation of roof slopes and fastening

patterns of insulation and base modified bitumen membrane, prior to job start.

D. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE 7-16 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before Work begins. Report shall be signed and sealed by a Professional Engineer registered in the State of the Project who has provided roof system attachment analysis for not less than 5 consecutive years.

E. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.
2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
3. Product reflectivity and emissivity criteria to qualify for one point under the LEED credit category, Credit 7.2, Landscape & Exterior Design to Reduce Heat Island - Roof.

F. Recycled or Bio-Based Materials: Provide third party certification through UL Environment of roof System membranes containing recycled or bio based materials

G. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

H. Manufacturer's Certificates: Provide to certify products meet or exceed specified requirements.

I. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147. Testing must be performed at 77 deg. F. Tests at 0 deg. F will not be considered.

J. Manufacturer's Fire Compliance Certificate: Certify that the roof system furnished is approved by Factory Mutual (FM), Underwritters Laboratories (UL), Warnock Hersey (WH) or approved thirs party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.

K. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual and manufacturers recommendations.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.

C. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.

D. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.

E. Product Certification: Provide manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

F. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer, the District Standard.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging with labels intact until ready for installation.

B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with "breathable" tarpaulins.

C. Stored in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface. No wet or damaged materials will be used in the application.

D. Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50 degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.

F. Adhesive storage shall be between the range of above 40 degree F (4 degree C) and below 80 degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.9 COORDINATION

A. Coordinate Work with installing associated metal flashings as work of this section proceeds.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under

environmental conditions outside manufacturer's absolute limits.

1.11 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed Edge-To-Edge NDL System Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material or defective workmanship by the installer, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition including Garland Metal Components.
   1. Warranty Period:
      a. 30 years from date of acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Garland Company, Inc. (The), which is located at: 3800 E. 91st St.; Cleveland, OH 44105; Toll Free Tel: 800-321-9336; Tel: 831-682-6827; Fax: 216-641-0633; Email:tchapman@garlandind.com Web:www.garlandco.com

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 HOT APPLIED 2-PLY ASPHALT ROOFING - STRESSPLY

A. Nailable Base Sheet: One ply fastened to the deck per wind uplift calculations.
   1. HPR Glasebase:

B. Base (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressBase 120:

C. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive.
   1. StressPly EUV FR Mineral

D. Interply Adhesive: (1 and 2)
   1. Generic Type IV Asphalt: Contractor Supplied, meets ASTM standards.

E. Flashing Base Ply: One ply bonded to the prepared substrate with Interply Adhesive: except torch sheet.
   1. VersiPly 40:

F. Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive: except torch sheet.
   1. StressPly EUV FR Mineral: Owner Supplied

G. Flashing Ply Adhesive:
   1. Generic Type IV Asphalt:

H. Surfacing:
   1. Aggregate/Flood Coat
      a. White-Star, Lucas ½” Fire Star gravel.

2.3 ACCESSORIES:

A. Roof Insulation: Tapered Fiberboard Crickets needed between drains, ½” : 12” tapered, wood nailers needed to match insulation heights at the eve, if needed.

B. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel, Fasteners shall be self-clinching type of penetrating type as recommended by the deck manufacturer. Fasten nails and fasteners flush-driven through flat metal discs not less than 1 inch (25 mm) diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than 1 inch (25 mm) diameter are used.

C. Urethane Sealant Hybrid - Tuff-Stuff MS: One part, non-sag sealant as approved and furnished by the membrane manufacturer for moving joints.
1. Tensile Strength, ASTM D 412: 250 psi
2. Elongation, ASTM D 412: 450%
3. Hardness, Shore A ASTM C 920: 35
4. Adhesion-in-Peel, ASTM C 92: 30 pli

2.4 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

A. Flashing Boot - Rubbertite Flashing Boot: Neoprene pipe boot for sealing single or multiple pipe penetrations adhered in approved adhesives as recommended and furnished by the membrane manufacturer.

B. Vents and Breathers: Heavy gauge aluminum and fully insulated vent that allows moisture and air to escape but not enter the roof system as recommended and furnished by the membrane manufacturer.

C. Pitch pans, Rain Collar 24 gauge stainless or 20oz (567gram) copper. All joints should be welded/soldered watertight. See details for design.

D. Drain Flashings should be 30” x 30” GreenWeld PVB formed and rolled.

E. Plumbing stacks should be GreenWeld PVB pre-formed and rolled, as supplied by the membrane manufacturer.

F. Liquid Flashing - Tuff-Flash: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.
1. Tensile Strength, ASTM D 412: 400 psi
2. Elongation, ASTM D 412: 300%
3. Density @77 deg. F 8.5 lb/gal typical

G. Fabricated Flashings: Fabricated flashings and trim are specified in Section 07620.
1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.

H. Manufactured Roof Specialties: Manufactured Fascia, R-Mer FORCE system and related flashings and trim as neede for NDL warranty.
1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.

D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. General: Clean surfaces thoroughly prior to installation.
1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.
3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.
5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pull-out capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with cap nails require a minimum pullout capacity of 40 lb. per nail.
7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

B. Wood Deck:
1. Dimensional wood deck shall be minimum 1 inch (25 mm) thick, knotholes and cracks larger than 1/4 inch shall be covered with sheet metal. All boards shall be appropriately nailed and have adequate end bearing to the centers of beams/rafters. Lumber shall be kiln dried.
2. Plywood shall be a minimum 15/32 inch (11.9 mm) thick and conform to the standards and installation requirements of the American Plywood Association (APA).
3. If no roof insulation is specified, provide a suitable dry sheathing paper, followed by an approved base sheet nailed appropriately for the specified roof system, with 1 inch (25 mm) diameter caps and annular nails unless otherwise required by the applicable Code or Approval agency.
4. Insulation is to be mechanically attached in accordance with the insulation manufacturer's recommendations unless otherwise required by the applicable Code.
5. In all retrofit roof applications, it is required that deck be inspected for defects. Any defects are to be corrected per the deck manufacturer's recommendations and standards of the APA/Engineered Wood Association prior to new roof application.
6. Light metal wall ties or other structural metal exposed on top of the wood deck shall be covered with one ply of a heavy roofing sheet, such as HPR Glasbase Base Sheet, extending 2 inches to 6 inches (51 mm to 152 mm) beyond the metal in all directions. Nail in place before applying the base ply.

3.3 INSTALLATION - GENERAL

A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors

Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.

B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
   1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
   2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.

C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water

D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.4 INSTALLATION HOT APPLIED ROOF SYSTEM

A. Base/Felt Ply(s): Install base sheet or felt plies in twenty five (25) lbs (11.3kg) per square of bitumen shingled uniformly to achieve one or more plies over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof. Do not step on base rolls until asphalt has cooled, fish mouths should be cut and patched.
   1. Lap ply sheet ends 8 inches (203 mm). Stagger end laps 2 inches (304mm) minimum.
   2. Install base flashing ply to all perimeter and projection details after membrane application.
   3. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
   4. Install base flashing ply to all perimeter and projection details.
   5. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.

B. Mechanically fasten ½” Viking ½” Secureock covernoard.

C. Modified Cap Ply(s): Solidly bond the modified membrane to the base layers with specified material at the rate of 25 to thirty 30 lbs. (11-13kg) per 100 square feet.
   1. Roll must push a puddle of hot material in front of it with material slightly visible at all side laps. Use care to eliminate air entrapment under the membrane. Exercise care during application to eliminate air entrapment under the membrane.
   2. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.
   3. Install subsequent rolls of modified membrane as above with a minimum of 4 inch (101 mm) side laps and 8 inch (203 mm) end laps. Stagger end laps. Apply membrane in the same direction as the previous layers but stagger the laps so they do not coincide with the laps of the base layers.
   4. Apply hot material no more than 5 feet (1.5 m) ahead of each roll being embedded.

5. Extend membrane 2 inches (50 mm) beyond top edge of all cants in full moppings of the specified hot material.

D. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.

E. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.
1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
3. Nailer lengths should be spaced with a minimum 1/8 inch gap for expansion and contraction between each length or change of direction.
4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.

F. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07620 or Section 07710. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.

G. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.

H. Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
2. Prepare all walls, penetrations, expansion joints and surfaces to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
3. Adhere to the underlying base flashing ply with specified hot material unless otherwise noted in these specifications. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
4. Solidly adhere the entire sheet of flashing membrane to the substrate.
5. Seal all vertical laps of flashing membrane with a three-course application of trowel-grade mastic and mesh.
6. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work as specified.
7. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.

I. Flood Coat/Aggregate:
1. Install after cap sheets and modified flashing, tests, repairs and corrective actions have been completed and approved.
2. Apply flood coat materials in the quantities recommended by the manufacturer.
3. Uniformly embed aggregate in the flood coat of cold adhesive at a rate recommended by the manufacturer.
4. Aggregate must be dry and placed in a manner required to form a compact, embedded overlay. To aid in embedment, lightly roll aggregate.

J. Flashing Cap Ply: Install flashing cap sheets by the same application method used for the base ply.
   1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
   2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
   3. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
   4. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
   5. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.
   6. All stripping shall be installed prior to flashing cap sheet installation.
   7. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.
   8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.

K. Roof Walkways: Provide walkways in areas indicated on the Drawings.

3.5 INSTALLATION EDGE TREATMENT AND ROOF PENETRATION FLASHING

A. R-MER Force Metal Edge Cap:
   1. Inspect the nailer to assure proper attachment and configuration.
   2. Run one ply over the edge. Assure coverage of all wood nailers. Fasten plies with ring shank nails at 8 inches (203 mm) o.c.
   3. Install continuous cleat and fasten at 6 inches (152 mm) o.c.
   4. Strip in cant dam with base flashing ply covering entire vertical area in bitumen with 6 inches (152 mm) on to the field of the roof. Assure ply laps do not coincide with metal laps.
   5. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof.
   6. Install new metal edge hooked to continuous cleat and set in bed of roof cement.
   7. Attach metal edge with approved fasteners and neoprene washers at 8 inches (203 mm) o.c.

B. Roof Edge With Gutter:
   1. Inspect the nailer to assure proper attachment and configuration. Increase slope at metal edge by additional degree of slope in first board.
   2. Run one ply over the edge. Assure coverage of all wood nailers. Fasten plies with ring shank nails at 8 inches (203 mm) o.c.
   3. Install gutter and strapping.
   4. Install continuous cleat and fasten at 6 inches (152 mm) o.c.
   5. Install new metal edge hooked to continuous cleat and set in bed of roof cement. Fasten flange to wood nailer every 3 inches (76 mm) o.c. staggered.
   6. Prime metal edge at a rate of 100 square feet per gallon and allow to dry.
   7. Strip in flange with base flashing ply covering entire flange in bitumen with 6 inches (152 mm) onto the field of the roof. Assure ply laps do not coincide with metal laps.
   8. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof.

C. Curb Detail/Air Handling Station:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install pre-manufactured counterflashing with fasteners and neoprene washers or per manufacturer's recommendations.
6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

D. Exhaust Fan:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply installed over the base flashing ply, 9 inches (228 mm) on to field of the roof. Attach top of membrane to top of wood curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install metal exhaust fan over the wood nailers and flashing to act as counterflashing. Fasten per manufacturer's recommendation.

E. Plumbing Stack:
1. Minimum stack height is 12 inches (609 mm).
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1 inch (25 mm) down inside of stack.

F. Heat Stack:
1. Minimum stack height is 12 inches (609 mm).
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install modified membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Install new collar over cape. Weld collar or install stainless steel draw brand.

3.6 PROTECTION

A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.

B. Protect exposed surfaces of finished walls with tarps to prevent damage.

C. Plywood for traffic ways required for material movement over existing roofs shall be not less

than 5/8 inch (16 mm) thick.

D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.

E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.7 FIELD QUALITY CONTROL

A. Inspection: Provide manufacturer's field observations at start-up and at intervals of approximately 30 percent, 60 percent and 90 percent completion. Provide a final inspection upon completion of the Work.
   1. Warranty shall be issued upon manufacturer's acceptance of the installation.
   2. Field observations shall be performed by a Technical Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
   3. Provide observation reports from the Technical Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
   4. Provide a final report from the Technical Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

3.8 SCHEDULES

A. Base (Ply) Sheet:
   1. StressBase 120: 120 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet with dual fiberglass reinforced scrim, performance requirements according to ASTM D 5147.
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
         2) 50mm/min. @ 23 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 110 lbf XD 110 lbf
         2) 50mm/min. @ 23 +/- 2 deg. C MD 489 N XD 489 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 2.5 % XD 2.5 %
         2) 50mm/min@ 23 +/- 2 deg. C MD 2.5 % XD 2.5 %
      d. Low Temperature Flexibility, ASTM D 5147, Passes -20 deg. F (-28.8 deg. C)

B. Modified Cap (Ply) Sheet:
   1. StressPly EUV FR Mineral (Environmental): 155 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) rubber modified roofing membrane reinforced with a dual fiberglass scrim and polyester scrim. ASTM D 6162, Type III Grade S:
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf/in XD 550 lbf/in
         2) (b) 50 mm/min. @ 23 +/- 2 deg. C MD 87.5 kN/m XD 96.25 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 900 lbf XD 950 lbf
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 4003 N XD 4226 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
      d. Low Temperature Flexibility, ASTM D 5147, Passes -30 deg. F (-34 deg. C)

C. Interply Adhesive:
   1. Generic Type IV Asphalt: Hot Bitumen, ASTM D 312, Type IV special steep asphalt having the following characteristics:
      a. Softening Point 210 deg. F - 225 deg. F
      b. Flash Point 500 deg. F
      c. Penetration @ 77 deg. F 15-25 units
      d. Ductility @ 77 deg. F 1.5 cm

D. Flashing Base Ply:
   1. VersiPly 40: 40 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet with dual fiberglass reinforced scrim.
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 215 lbf/in XD 215 lbf/in
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 37.5 kN/m XD 37.5 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 275 lbf XD 275 lbf
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 1223 N XD 1223 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 4.5% XD 4.5%
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 4.5% XD 4.5%
      d. Low Temperature Flexibility, ASTM D 5147
         1) Passes -30 deg. F (-34 deg. C). Meets or Exceeds ASTM D 4601 Type II Performance Criteria.

E. Flashing Ply Adhesive:
   1. Generic Type IV Asphalt: Hot Bitumen, ASTM D 312, Type IV special steep asphalt having the following characteristics:
      a. Softening Point 210 deg. F - 225 deg. F
      b. Flash Point 500 deg. F
      c. Penetration @ 77 deg. F 15-25 units
      d. Ductility @ 77 deg. F 1.5 cm

F. Surfacing:
   1. Flood Coat/Aggregate:
      a. White-Star with All-Knight Primer: Polyurea flood coat adhesive: White Star; one-component, flexible, low odor, polyurea roof adhesive top coat. Performance Requirements:
         1) Non-Volatile Content ASTM D 2369 89%
         2) Density 9.85 lbs./gal.
         3) V.O.C. Less than 130 g/L
         4) Viscosity at 77 deg. F Brookfield viscometer 60 poise
         5) Flash Point ASTM D 93 120 deg. F (41 deg. C)
         6) Roofing Aggregate: ASTM D 1863
            a) Slag.
            b) Pea gravel.
            c) White spar.
   2. Flashing Cap (Ply) Sheet:
      a. StressPly EUV FR Mineral: 155 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) rubber modified membrane incorporating post-consumer recycled rubber, fire retardant additives and reinforced with a fiberglass and polyester composite scrim. Surfaced with the highly reflective Sunburst white mineral. ASTM D 6162, Type III Grade G
         1) Tensile Strength, ASTM D 5147
            a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 700 lbf/in XD 750 lbf/in
            b) 50 mm/min. @ 23 +/- 2 deg. C MD 122.5 kN/m XD 131.25 kN/m

2) Tear Strength, ASTM D 5147
   a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 1300 lbf XD 1400 lbf
   b) 50 mm/min. @ 23 +/- 2 deg. C MD 5783 N XD 6227 N
3) Elongation at Maximum Tensile, ASTM D 5147
   a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
   b) 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
4) Low Temperature Flexibility, ASTM D 5147, Passes -30 deg. F (-34 deg. C)
5) Reflectivity, ASTM C 1549: 73%

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sheet metal flashing and trim not specifically specified in other sections.

B. Related Sections:
   1. Division 9 Section “Painting” for painting of sheet metal flashing and trim.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
   6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.

7. Details of special conditions.
8. Details of connections to adjoining work.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheet metal flashing and trim that fails in materials or workmanship within specified warranty period.
1. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Galvanized Sheet Metal Flashing and Trim:
1. Fry Reglet Corporation.
2. Hickman, W. P. Company.
3. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
4. Or equal.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
   1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

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

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods,

protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.

G. Flashing corners shall be shop fabricated and fully soldered such that corner assemblies are single monolithic units for 18" in all directions from corners.

3.3 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
   1. Fasten gutter spacers to front and back of gutter.
   2. Loosely lock straps to front gutter bead and anchor to roof deck.
   3. Anchor and loosely lock back edge of gutter to continuous cleat.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
   1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
   2. Connect downspouts to underground drainage system indicated.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 076500 - FLEXIBLE SHEET FLASHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Flexible sheet flashing for windows, doors, parapets, and other openings and where indicated on Drawings.

1.3 SUBMITTALS

A. Concurrent Review Requirements: Submit submittals of this section with doors and windows sections.

B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of flexible sheet flashing.

C. Shop Drawings: Show locations and extent of flexible sheet flashing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

D. Samples: For the following products:
   1. 12-by-12-inch square of flexible sheet flashing.

E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for flexible sheet flashing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is acceptable to flexible sheet flashing manufacturer for installation of flexible sheet flashing required for this Project.

B. Source Limitations: Obtain flexible sheet flashing materials through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by flexible sheet flashing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of flexible sheet flashing that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Flexible Sheet Flashing: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. WR Grace (Basis of Design).
   2. FortiFlash by Fortifiber.
   3. FlexWrap and StraightFlash by DuPont.
   4. Or equal.

2.2 FLEXIBLE SHEET FLASHING

A. Product: Vycor Plus by WR Grace or equal.
   1. Self-Adhered, cross-laminated high-density polyethylene (HDPE) sheet, backed by aggressive pressure-sensitive rubberized asphalt adhesive.
   2. Thickness: 25 mil minimum per ASTM D3767, Method A.
   3. Low temperature flexibility: Unaffected at minus 45 degrees F. per ASTM D1970.

4. Elongation, ultimate failure of rubberized asphalt: 200 percent minimum per ASTM D412.
5. Cracked cycling 100 cycles: Unaffected at minus 25 degrees F. per ASTM C836.
6. Lap adhesion at minimum application temperature: 60 plf width per ASTM D1876 modified.
7. Adhesion to concrete at minimum application temperature: 60 plf width per ASTM D903.
8. ICC ES ESR-3727 Approval per the requirements and standards as set forth in AC-38 (Acceptance Criteria for Water Resistive Barriers) as a Water Resistive Barrier and Air Barrier.
9. Recommended exposure limit: 30 days.
10. Perm-A-Barrier by Grace is not acceptable.

2.3 AUXILIARY MATERIALS

A. Mastic, Joint Sealant, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by flexible sheet flashing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
   1. Verify that concrete has cured and aged for minimum time period recommended by flexible sheet flashing manufacturer.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install flexible sheet flashing in accordance with the manufacturer’s written instructions, AAMA Publication 2400, and the applicable code.

END OF SECTION 076500

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Roof hatches.

B. Related Sections:
   1. Division 9 Section “Painting” for field finishes.

1.3 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
   1. With Architect's approval, adjust location of roof accessories that would interrupt roof drainage routes.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of roof accessories that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Roof Hatches and Heat and Smoke Vents: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Bilco Company (The). (Basis of Design)
   2. Babcock-Davis.
   3. Milcor Inc.; a Gibraltar Company.
   4. Nystrom, Inc.
   5. O'Keeffe's Inc.
   6. ThyCurb; Div of Thybar Corporation.
   7. Or equal.

2.2 METAL MATERIALS

A. Galvanized Steel Sheet: ASTM A 653, G90 coated and mill phosphatized for field painting.
   1. Comply with Division 9 Section “Painting” for field finishes.

B. Steel Shapes: ASTM A 36, hot-dip galvanized to comply with ASTM A 123, unless otherwise indicated.

C. Steel Tube: ASTM A 500, round tube, baked-enamel finished.

D. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123.

E. Galvanized Steel Pipe: ASTM A 53.

2.3 MISCELLANEOUS MATERIALS

A. Glass-Fiber Board Insulation: ASTM C 726, 1 inch thick.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

C. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

E. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
   1. Caulking and sealants applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
   1. Caulking and sealants applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

G. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.
   1. Caulking and sealants applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.4 ROOF HATCHES

A. General: Fabricate roof hatches with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

B. Product: Type S or E depending on size by Bilco or equal.
   1. Type: Galvanized 14 gauge paint bond G-90 galvanized steel single (S) or double-leaf (E) lid as indicated on Drawings.
   2. Size: As indicated on Drawings but minimum 30 by 37 inches.
   3. Cover:
      a. 3 inch beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
      b. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
      c. Operation of the cover shall not be affected by temperature.
      d. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
   4. Cover insulation: Shall be fiberglass of 1 inch thickness, fully covered and protected by a metal liner 22 gauge paint bond G-90 galvanized steel.
   5. Curb: 12 inch in height with integral capflashing, 1 inch fiberboard insulation, fully welded at corners, and 3-1/2 inch mounting flange with 7/16 inch holes provided for securing frame to the roof deck.
   6. Curb insulation: Shall be rigid, high-density fiberboard of 1 inch thickness on outside of curb.
   7. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.
   8. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation. Bil-Guard Hatch Rail System or equal.
   9. Finish: Comply with Division 9 Section ”Painting”.

2.5 FINISH

A. Galvanized Steel: Field finish per Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
   2. Verify dimensions of roof openings for roof accessories.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
   3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Roof Hatch Installation:
   1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
   2. Attach safety railing system to roof hatch curb.
   3. Attach ladder safety post according to manufacturer's written instructions.

3.3 TOUCH UP

A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.

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

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:
   1. Through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, whether indicated on drawings or not, and other openings indicated.

B. Related Sections include the following:
   1. Division 7 Section "Fire-Resistive Joint Systems."
   2. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
   1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
   2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
   1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
      a. Penetrations located outside wall cavities.
      b. Penetrations located outside fire-resistance-rated shaft enclosures.
   3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
   2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
   3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
   2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
   1. Types of penetrating items.
   2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
   3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
      a. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
         1) UL in its "Fire Resistance Directory."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of through-penetration firestop system that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Through-Penetration Firestop Systems: Subject to compliance with requirements, provide one of the through-penetration firestop systems for each application that are produced by one of the following manufacturers.
   1. Hilti, Inc.
   2. Specified Technologies Inc.
   3. 3M; Fire Protection Products Division.
   4. Or equal.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-/rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

C. Caulking, sealants, and adhesives applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
   2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
   3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
   1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Through-penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Through-penetration firestop system manufacturer's name.
   6. Installer's name.

B. Marking and Identification: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
   1. Be located in accessible concealed floor, floor-ceiling or attic spaces.
   2. Be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partitions.
   3. Include lettering not less than 0.5 inch in height, incorporating the suggest wording: “fire and/or smoke barrier – protect all openings,” or other wording.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM LOCATION

A. Provide assemblies as indicated on Drawings. Provide following products for additional locations not identified on Drawings.

B. For penetrations by non combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:
   1. Hilti FS 601 Elastomeric Firestop Sealant.
   2. Hilti FS ONE High Performance Intumescent Firestop Sealant.
   3. 3M Fire Stop Sealant 2000 4. 3M Fire Barrier CP25 WB.
   4. Tremco Tremstop Fyre Sil Sealant.
   5. Or equal.

C. For penetrations by combustible items (penetrants consumed by high heat flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems) the following materials are acceptable:
   1. Hilti FS ONE High Performance Intumescent Firestop Sealant.
   2. Hilti CP 618 Firestop Putty.
   3. Hilti CP 642 Firestop Jacket.
   4. Hilti CP 643 Firestop Jacket.
   5. 3M Fire Barrier CP25 WB.
   6. 3M Fire Barrier FS 195 Wrap/Strip.
   7. Tremco Tremstop WBM Intumescent Firestop Sealant.
   8. Or equal.

D. For penetrations by combustible plastic pipe (open piping systems), the following materials are acceptable:
   1. Hilti CP 642 Firestop Jacket.
   2. Hilti CP 643 Firestop Jacket.
   3. Hilti FS ONE High Performance Intumescent Firestop Sealant.
   4. 3M Fire Barrier PPO Plastic Pipe Device.
   5. Or equal.

E. For large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways' the following materials are acceptable:
   1. Hilti FS 635 Trowelable Firestop Compound.
   2. Hilti FIRE BLOCK.
   3. 3M Firestop Foam 2001.
   4. 3M Fire Barrier CS 195 Composite Sheet.
   5. Or equal.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fire-resistive joint systems for interruptions to fire rated assemblies, whether indicated on drawings or not, and other openings indicated.

B. Related Sections include the following:
   1. Division 7 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
   2. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.
   1. Load-bearing capabilities as determined by evaluation during the time of test.

C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICC ER Reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
      a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
      b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fire-resistive joint systems that fails in materials or workmanship within specified warranty period.
1. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire-Resistive Joint Systems: Subject to compliance with requirements, provide one of the through-penetration firestop systems for each application that are produced by one of the following manufacturers.
1. Hilti, Inc.
2. Specified Technologies Inc.
3. 3M; Fire Protection Products Division.
4. Or equal.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
   1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
   2. Apply fill materials so they contact and adhere to substrates formed by joints.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.
   1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

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

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 FIRE-RESISTIVE JOINT SYSTEM LOCATION

A. For fire rated construction joints and other gaps, the following materials are acceptable:
   1. FS 601 Elastomeric Firestop Sealant by Hilti.
   2. CP 601 s Elastomeric Firestop Sealant by Hilti.
   3. CP 606 Flexible Firestop Sealant by Hilti.

4. CP 672 Firestop Joint Spray by Hilti.
5. Firestop Sealant 2000 by 3M.
6. Tremstop Fyre Sil Sealant by Tremco.
7. Or equal.

B. For openings between structurally separate sections of wall and floors. Top of walls, the following materials along with Thermafiber Safing are acceptable:
1. FS 60t Elastomeric Firestop Sealant by Hilti.
2. CP 601s Elastomeric Firestop Sealant by Hilti.
3. CP 606 Flexible Firestop Sealant. by Hilti
4. FS ONE High Performance Intumescent Firestop Sealant by Hilti.
5. Fire Barrier CP 25 WB by 3M.
6. Or equal.

C. Firestopping at Electrical Boxes and Utility Outlets.
1. CP 618 Firestop Putty Stick by Hilti.
2. CP 617 and CP 617L Firestop Putty Pad by Hilti.
3. Or equal.

END OF SECTION 078446

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes joint sealants.

B. Related Sections include the following:
   1. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
   2. Division 7 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

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

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

E. Qualification Data: For Installer.

F. Compatibility and Adhesion 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 needed for adhesion.

G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

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

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 2 years.

B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
   1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

C. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 2 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Joint Sealants: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Sika Corporation
   2. Pecora Corporation.
   3. Bostik.
   4. Dow Corning Corp.
   5. GE Plastics.
   6. Sonneborn Building Products, ChemRex, Inc.
   7. Tremco, Inc.
   8. The Sherwin-Williams Company.
   9. Or equal.

2.2 MATERIALS, 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 sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants:
   1. As selected by Architect from manufacturer's full range.
   2. Areas where concrete joint sealant will be adjacent to concrete other than standard gray, sealant color shall match adjacent color as approved by Architect.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
   3. Remove laitance and form-release agents from concrete.
      a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 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. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
   4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

I. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
   1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
   2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
   3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
   4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

J. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 JOINT-SEALANT LOCATION

A. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.
   1. Products:
      a. SikaFlex 1A or 15LM by Sika Corp.
      b. Dynatrol I-XL by Pecora.
      c. Stampede 1 by The Sherwin-Williams Company.
   2. Color: Standard colors matching finished surfaces.
   3. Applications:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.

c. Joints between metal frames and other materials.
d. Other exterior joints for which no other sealant is indicated.

B. Exterior Metal Lap Joint Sealant: Silicone, Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
1. Products:
a. SikaSil WS-295 Silicone by Sika Corp.
b. 895 Silicone or Sil-Span by Pecora.
2. Color: Standard colors matching finished surfaces.
3. Applications:
a. Concealed sealant bead in sheet metal work.
b. Concealed sealant bead in siding overlaps.

C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
1. Products:
a. AC-20 manufactured by Pecora.
b. 950A manufactured by The Sherwin-Williams Company.
2. Color: Standard colors matching finished surfaces.
3. Applications:
a. Interior wall and ceiling control joints.
b. Joints between door and window frames and wall surfaces.
c. Other interior joints for which no other type of sealant is indicated.

D. Interior Floor Joint Sealant: Polyurethane, chemically-curing, cold-applied, self-leveling elastomeric sealant; ASTM C 920, Grade P, Class 25, Uses T, M and A; two-part.
1. Products:
a. SikaFlex 2C SL or NS with TG Additive by Sika Corp.
b. NR-200 self-leveling polyurethane and/or DYNATRED non-sag, traffic-grade polyurethane sealants by Pecora.
c. Stampede 2SL by The Sherwin-Williams Company.
2. Primer: SikaFlex 429 Primer; P-150, P-75 or P-200.
3. Color: Standard colors matching finished surfaces.
4. Applications: Use for joints up to 1-1/2 inches.
a. Expansion joints in floors.

E. Concrete Paving Joint Sealant: Polyurethane, chemically-curing, cold-applied, self-leveling elastomeric sealant; ASTM C 920, Class 25, Uses T, I, M and A; two-part.
1. Products:
a. NR-200 Urexpan and/or DYNATRED non-sag, traffic-grade polyurethane sealant by Pecora or equal.
b. Stampede 2NS by The Sherwin-Williams Company.
2. Primer: SikaFlex 429 Primer; P-150, P-75 or P-200.
3. Color: Gray or Limestone.
4. Applications:
a. Joints in sidewalks and vehicular paving.

F. Butyl Sealant: ASTM C 920, Grade NS, Class 12-1/2, Uses NT, M, A, G, O; single component, solvent release, non-skinning, non-sagging.
1. Products:

a. BC-158 sealant by Pecora.
b. WL Silicone Rubber by The Sherwin-Williams Company.

2. Color: Standard colors matching finished surfaces.
3. Movement Capability: Plus and minus 12-1/2 percent.
4. Service Temperature Range: -13 to 180 degrees F.
5. Shore A Hardness Range: 10 to 30.

G. Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, M, O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.

1. Products:
   a. SikaSil WS 290 or WS 295 by Sika Corp.
   b. 864 LM Architectural silicone or 890 silicone sealant by Pecora.
   c. 790 by Dow Corning Corporation.
   d. WL Silicone Ultra WL09210.
2. Color: Standard colors matching finished surfaces.
3. Movement Capability: Plus and minus 25 percent.
4. Applications:
   a. Interior or exterior for joints 1/8 to 1-1/2 inch wide.
   b. Exterior use at expansion joints in masonry where substantial movement is expected.
   c. Glazing application.

END OF SECTION 079200

SECTION 081113 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Standard hollow metal doors and frames.
2. Hollow metal windows.
3. Hollow metal acoustical windows.
4. Hollow metal acoustical doors and frames.

B. Related Sections include the following:
1. Division 8 Section “Door Hardware” for door hardware for hollow metal doors.
2. Division 9 Section “Painting” for field painting hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL-10C.

1. Temperature-Rise Limit: Where required, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure per CBC Section 715.4.4.

C. Smoke-Control Door Assemblies: Comply with CBC Section 715.4.3.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel doors and frames that fails in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Doors and Frames and Sidelites: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Ceco Door Products; an Assa Abloy Group company. (Basis of Design)
   2. Steelcraft; an Ingersoll-Rand company.
   3. Curries Company; an Assa Abloy Group company.
   4. Or equal.

B. Acoustical Steel Windows and Doors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Ambico Limited. (Basis of Design)
   2. Or equal.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications for interior doors and frames.

B. Galvannealed (Metallic-Coated) Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum A60 metallic coating for exterior doors and frames.

C. Frame Anchors: ASTM A 591, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.

E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

F. Glazing: Comply with requirements in Division 8 Section "Glazing."
   1. Wired glass is not allowed.
   2. Tempered or fire-rated where required.

2.3 STANDARD HOLLOW METAL DOORS AND WINDOWS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
   1. Design: Flush panel.
   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

a. Standard Core: Honeycomb, U-factor of 0.69, R-value of 1.45.
b. Fire Door Core: As required to provide fire-protection indicated.

3. Vertical Edges for Single-Acting Doors: Beveled edge.
   a. Beveled Edge: 1/8 inch in 2 inches.
4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
7. Vision, Narrow Lite, Half Glass Doors: Size as indicated on Drawings.

B. Exterior Doors: Face sheets fabricated from galvannealed (metallic-coated) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush):
      a. Face thickness: 16 gage (0.053 inch).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless galvanized (metallic-coated) sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush):
      a. Face thickness: 18 gage (0.042 inch).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frame: 14 gage (0.067-inch) thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded. Knocked down is not allowed.
   3. Frame: 16 gage (0.053-inch) thick steel sheet.
   4. Frames for Wood Doors: Same type as for steel doors.
   5. Frames for Borrowed Lights: Same as adjacent door frame.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 ACOUSTICAL STEEL WINDOWS AND DOORS

A. Product: Acoustic Steel Window Frame Assemblies by Ambico or equal.
   1. Sheet Steel: Galvanized steel to ASTM A653, ZF180 (A60).
   2. Manufacture window frame assemblies to STC rating of 56 and door assemblies to STC rating of 59, unless otherwise indicated, measured in accordance with ASTM E90. These items are designed to be fixed-in place and shall be inoperable.
   3. Frame thickness: 10 inches nominal.
   4. Acoustical Laminated Glazing: Manufacturer's integral acoustical assembly.
   5. Fabrication:
      a. Factory assemble and weld window frames.
      b. Sheet steel, metal thickness and appropriate to maintain door STC ratings.
      c. Mitred corners, fully welded seams where window frame members intersect.
      d. Factory-supply glazing in conformance with tested standards. Glazing shall be supplied loose ready for field assembly by others. Glazing details will vary widely in accordance with specified STC ratings.
      e. Affix permanent metal nameplates to window frame assembly, indicating manufacturer's name, frame tag and STC rating where it shall be clearly visible.
      f. Finish: Comply with Division 9 Section "Painting".

2.6 FRAME ANCHORS

A. Jamb Anchors:
   1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
   3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 LOUVERS

A. Provide louvers for doors, where indicated, that comply with SDI 111C.
   1. Inserted Louver:
      a. 18 gage steel, welded to fabricated sub-frame.
      b. 1 inch thick, inverted “Y” blade type, inserted into opening prepared in door faces.
      c. Free air space: 50% of louver area.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

C. Provide Screw-In Top Cap for exterior doors.

2.10 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances:
   1. Standard doors and frames: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   2. Glazed Lites: Factory cut openings in doors.
   3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
   3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
   b. Compression Type: Not less than two anchors in each jamb.
   c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

H. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
1. Maximum Rate: 0.3 cfm/sq. ft. of area at an inward test pressure of 1.57 lbf/sq. ft.
2. Maximum Rate: 0.1 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft.

2.11 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Field-Applied Paint Finish: Comply with Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

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

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

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

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
      a. Post-installed expansion anchors shall comply with IR 19-1.
      b. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
   4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
   5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
      d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
   2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
   3. Smoke-Control Doors: Install doors according to UBC Standard 7-2.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

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

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

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes solid-core doors.

B. Related Sections include the following:
   1. Division 8 Section "Steel Doors and Frames" steel door frames.

1.3 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Other Action Submittals:
   1. Schedule: Provide a schedule of flush wood door work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
      a. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
      b. Indicated specific model number of door and frame.
      c. Indicated hardware group.
      d. Indicate dimensions and locations of mortises and holes for hardware.
      e. Indicate dimensions and locations of cutouts.
      f. Indicate doors to be factory finished and finish requirements.
      g. Indicate fire ratings for fire doors.

C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
   1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.

D. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors."
1. Performance duty Level: Extra Heavy Duty.
2. Factory machined for door hardware and high density hardware blocking.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to CBC Section 715.
1. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
2. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch top to bottom, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty:
   a. Solid-Core Interior Doors: Life of installation.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Flush Wood Doors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Architectural Series by Oregon Door. (Basis of Design)
   a. Profile: Standard Profile, PC-5.
2. Masonite (Marshfield-Algoma, Graham-Maiman) Inc.
3. Eggers Industries; Architectural Door Division (VT Industries).
4. Marlite.
5. Haley Brothers, Inc.
6. Or equal.

2.2 DOOR CONSTRUCTION, GENERAL

A. Adhesives: Do not use adhesives containing urea formaldehyde.

B. Doors for Transparent Finish:
1. Grade: Custom (Grade A faces)**.**
2. Species and Cut: White maple, rotary cut.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces: Running match.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Stiles: Same species as faces**.**

2.3 SOLID-CORE DOORS

A. Core:
1. Structural-Composite-Lumber-Core: WDMA I.S.10.
   a. Screw Withdrawal, Face: 700 lbf.
   b. Screw Withdrawal, Edge: 400 lbf.

B. Doors:
1. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Veneer-Faced Doors:

1. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

D. Fire-Rated Doors:
1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. Pairs: Furnish formed-steel edges and astragals with intumescent seals for pairs of fire-rated doors, unless otherwise indicated.
a. Finish steel edges and astragals with baked enamel same color as doors.

2.4 DOOR FRAMES

A. Hollow Metal Frames: Comply with Division 8 Section “Steel Door and Frames”.

2.5 FABRICATION

A. Fabricate doors in sizes indicated for Project-site fitting.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing.

B. Finish doors at factory.

C. Transparent Finish:
1. Grade: Custom.
2. Finish: NWWDA I.S.1-A System TR-6 catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
   1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
      a. Comply with NFPA 80 for fire-rated doors.
   2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
   3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:
   1. Division 8 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
   2. Division 9 Section “Painting” for field applied finishes.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of access doors and frames that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Access Doors and Frames: Subject to compliance with requirements, provide products by one of the following:
   1. Karp Associates Inc.
   2. Acudor.
   3. Milcor Inc.
   4. Nystrom, Inc.
   5. MIFAB.
   6. Or equal.

2.2 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.
   1. ASTM A 123, for galvanizing steel and iron products.
   2. ASTM A 153, for galvanizing steel and iron hardware.

B. Steel Sheet: Cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.

C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Factory Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
   2. Field Finish: Factory prime for field painting as specified in Division 9 “Painting”.

D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Recessed Door to Receive Drywall Type:
   1. Fire-Rated: Model 450FR by Karp.
   2. Non-Fire-Rated: Model RDW by Karp.
   3. Frame shall be 14 gage steel and doors shall be 16 gage steel.
   4. Door shall be recessed 1 inch.
   5. Trim shall be galvanized steel dry wall bead.
   6. Hinge shall be concealed pivoting rod type.
   7. Locks shall be flush and screwdriver operated with stainless steel cam and studs, or shall be key operated cylinder lock with automatic dust shutter.
   8. Finish shall be prime coat of rust inhibitive electrostatic powder, baked grey coat.
   9. Door Sizes:
      a. As indicated on Drawings.
   10. Field Finish: Comply with Division 9 Section “Painting”.

B. Flange Type:
   1. Fire-Rated: Model KRP-250 by Karp.
   2. Non-Fire-Rated: Model DSC-214M by Karp.
   3. Frame shall be 14 gage steel and doors shall be 16 gage steel.
   4. Flange: One-piece construction, 3/4 inch wide.
   5. Hinge shall be concealed continuous piano hinge.
   6. Locks shall be flush and screwdriver operated with stainless steel cam and studs, or shall be key operated cylinder lock with automatic dust shutter.
   7. Finish shall be prime coat of rust inhibitive electrostatic powder, baked grey coat.
   8. Door Sizes:
      a. As indicated on Drawings.
   9. Field Finish: Comply with Division 9 Section “Painting”.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
   1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.5 FINISHES

A. Field finish per Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Glazing to match existing windows and doors.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
   1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

C. Qualification Data: For installers.

D. Product Test Reports: For each types of glazing products specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain glazing products through one source from a single manufacturer for each glass type as practical.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
   1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
   1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

F. Safety Glazing Products: Comply with requirements in CBC Section 2406.1.
   1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the manufacturer acceptable to authorities having jurisdiction, in compliance with CBC Section 2406.3.
   2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications:
      a. GANA's "Glazing Manual."
      b. GANA Laminated Division's "Laminated Glass Design Guide."
   2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
   1. Insulating Glass Certification Council.
   2. Associated Laboratories, Inc.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Glass Products:
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass Manufacturers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Vitro.
   2. Guardian.
   3. Pilkington.
   4. Visteon.
   5. Or equal.

2.2 GLASS PRODUCTS

A. Heat-Treated Float Glass (Safety Glass): ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
   1. For uncoated glass, comply with requirements for Condition A.

2. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
3. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
   a. Class II tempered safety glazing per CBC 2406.3 and Table 2406.2(1).

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
   1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where indicated.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Fixed, extruded-aluminum louvers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Samples for Initial Selection: For units with factory-applied color finishes.

C. Samples for Verification: For each type of metal finish required.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

1.5 PROJECT CONDITIONS

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

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of louvers and vents that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Louvers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Industrial Louvers, Inc. (Basis of Design)
   2. Greenheck.
   3. Airline Products Co.
   4. Airolite Company (The).
   5. Construction Specialties, Inc.
   6. Ruskin Company.
   7. Architectural Louvers.
   8. Or equal

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26, alloy 319.

D. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use screws for exposed fasteners, unless otherwise indicated.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
   1. Caulking and sealants applied on the interior of the building envelope shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.3 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
   1. Frame Type: Channel, unless otherwise indicated.

C. Include supports, anchorages, and accessories required for complete assembly.

D. Provide subsills made of same material as louvers or extended sills for recessed louvers.

E. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver:
   1. Product: ILI 5” Deep Sight Proof Drainable Blade Model 413SXP by Industrial Louvers or equal.
   2. Shapes and Sizes: As indicated on Drawings**.**
   3. Sizes: As indicated on Drawings.
   4. Frame and blade thickness to be .081” extruded aluminum 6063-T6 alloy.
   5. Frame shall be designed to collect and drain water to exterior at sill by means of channels in the jambs.
   6. Sill and jamb frame shall be continiously welded and caulked to prevent water penetration to interior wall construction.
   7. Blades are attached by means of all welded (or mechanically fastened) assembly.
   8. Louver to be supplied with 3.5” high sill pans with welded end dams.
   9. Louvers shall bear the AMCA Certified Rating Seal for both air performance and Wind Driven Rain ratings.
   10. Louvers shall have a minimum of 8.00 sq. ft. (50%) of free area on a 48” x 48” louver.
   11. Louver manufacturer shall submit certified water penetration test data at a rainfall rate of 3 inches per hour with a wind directed at the louver face at a velocity of 29.1 mph.
   12. Test data shall show the following results (on a 1m2 core area unit) maintaining a .99 effectiveness rating:
      a. Maximum intake core velocity = 2.46 m/s (484 fpm).
      b. Maximum free area velocity = 4.34 m/s (854 fpm).
      c. Intake pressure drop = 44.7 Pa (.180 in. wg).
      d. Intake capacity = 2.46 m3/s (5208 cfm).
   13. Louver Screens: Provide framed removable screens for exterior louvers.
      a. Screens shall be insect screen type flattened expanded aluminum screen mounted in an extruded aluminum removable frame.
      b. Locate screens on inside face of louvers.

c. Screen frames shall have welded corners and be secured to the louver frame with machine screws, at each corner and at 12" c.o. between.

14. Shop Finishing: Factory finish louvers and accessories with an organic coating.
    a. Organic Coating: Clean and prime exposed aluminum surfaces and apply a Kynar 500/Hylar 5000 2-coat finish conforming to AAMA 605 in a standard color to be selected by Architect. Minimum dry film thickness shall be 1.2 mil.
    b. Finish Protection: Provide finish protection as recommended by louver manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

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

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

C. Vandal Protection: Louvers located in accessible areas shall use special vandal resistant hardware for installation.

D. Form closely fitted joints with exposed connections accurately located and secured.

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

F. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
   1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 092216 - NON-LOAD-BEARING STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:
   1. Interior suspension systems.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Deflection track: List location of use.

C. Certification of Materials: For steel framing materials.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Construction Standards: Construction not on Drawings or referenced shall be as detailed in Technical Library by SSMA Technical Services.

D. Deflection Limits: Maximum deflection of following at 5 psf.
   1. Gypsum board assemblies: L/240.
   2. Ceramic tile: L/360.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of non-load bearing steel framing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 1 year.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Non-Load-Bearing Steel Framing: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. California Expanded Metal Products Company (CEMCO).
2. Clark Steel Framing Systems.
3. Consolidated Systems, Inc.
4. Dale/Incor.
5. Dietrich Industries, Inc.
6. Unimast, Inc.
7. Western Metal Lath & Steel Framing Systems.
8. Or equal.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 18 gage minimum.

B. Wire Hangers: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 inch (12 gage) diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (16 gage) and minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings, but not less than 1-1/2 inch.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Depth: As indicated on Drawings.
2. Minimum Base Metal Thickness: As indicated on Drawings, but not less than 0.0296 thick (20 gage).

E. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission.
1. Leg Configuration: As indicated on Drawings.
2. Minimum Base Metal Thickness: As indicated on Drawings, but not less than 0.0296 thick (20 gage).

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
   2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092400 - PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior three-coat portland cement plasterwork (stucco) on metal lath system.
   2. Integral colored finish coat and field painted.

B. Related Sections:
   1. Division 6 Section “Sheathing” for exterior sheathing.
   2. Division 7 Section "Building Insulation" for thermal insulations included in portland cement plaster assemblies.
   3. Division 7 Section “Flexible Sheet Flashing” for flashing windows, door, and other openings.
   4. Division 7 Section "Joint Sealants" for acoustical sealants and sealants installed with exterior portland cement plaster (stucco).
   5. Division 9 Section “Painting” for field painting of plaster.

1.3 SUBMITTALS

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

B. Shop Drawings:
   1. Showing details of construction for framing, reinforcement, and trims; including locations where each type material, mix, coating thickness, material sizes and thicknesses, and fastenings will be used.
   2. Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.
   3. Include details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections to other work.
   4. Show locations and extent of weather-barrier (building paper and flashing sheet). Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
      a. Include details of interfaces with other materials that form part of weather barrier.
      b. Include details of mockups.

C. Coordination Drawings:

1. Comprehensive, completely integrated set of plans, sections, elevations, and details, drawn to scale, of separate trades work, indicating interface support/connections, and relationships between materials, and products, on which the following items are shown and coordinated with each other, based on input from fabricators and installers of the items involved:
    a. Framing, including backing, blocking, strapping, and similar accessory/sub-framing materials.
    b. Sheathing, including building paper.
    c. Portland cement plaster, including trim and self-adhering flashing sheet.
    d. Other materials and products that occur in, on, adjacent to, or contiguous with above work.
2. At a minimum, indicate the following
    a. Locations/spacing of plaster trim moldings.
    b. Locations/dimensions of self-adhering flashing sheet (underlying trim moldings).
    c. Locations/spacings of connections/fastenings of:
        1) Sheathing
        2) Metal lath.
        3) Plaster trim moldings
    d. Sequence of installation of:
        1) Building paper.
        2) Flexible flashing.
        3) Metal lath, and plaster trim moldings.

D. Samples for Initial Selection: For each type of factory-prepared finish coat indicated with texture and color.

E. Samples for Verification: For each type of factory-prepared finish coat indicated; 12 by 12 inches, and prepared on rigid backing with color selected.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

B. Mockups: Before plastering, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Comprehensive, completely integrated mockups of separate trades work, indicating interface connections, transitions, relationships between materials and finishes, and quality of workmanship. Coordinated mockups shall include, but is not limited to, the following:
    a. Work of this Section.
    b. Framing, including backing, blocking, strapping, and similar accessory/sub-framing materials.
    c. Sheathing, including building paper.
    d. Sealants.
    e. Penetrations of portland cement plaster assemblies.
    f. Other materials and finishes that are within indicated area of coordinated mockups, including barrier/backing/support for above work.
2. Install mockups for each type of finish indicated.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

4. Use of self-furring lath is subject to satisfactory jobsite demonstration for each project of lath installation, with approval by Inspector of Record.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PROJECT CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Exterior Plasterwork:
1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F.
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cement plaster system that fail in materials within specified warranty period. Failure includes, but is not limited to, blistering, peeling, flaking, delaminating, rusting, checking, crazing, fading beyond manufacturer's published limits, or chipping as a result of manufacturing defects.
1. Warranty Period: 3 years.

B. Special Waterproof Warranty: Submit cement plaster system manufacturer's warranty certifying that work of this Section has been properly applied in strict accordance with system manufacturer's recommended procedures, instructions, and systems current applicable specifications; has been properly integrated into building construction in accordance with sound design and building construction practices; and will remain resistant to water penetration for specified warranty period.
1. Warranty Period: 3 years.

C. Weather Resistive Barriers: 10 years.

D. Installer’s Warranty:
1. Warranty Period: 2 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Plaster System: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Omega. (Basis of Design)
2. LaHabra Stucco.
3. Merlex.
4. Sto.
5. Or equal.

B. Metal Lath: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Clark Western Metal Lath & Steel Framing Systems.
2. Alabama Metal Industries Corporation (AMICO).
3. California Expanded Metal Products Company (CEMCO).
4. Dale/Incor.
5. Unimast, Inc.
6. Structa Wire Corp.
7. Or equal.

A. Weather-Resistant Barrier: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Fortifiber.(Basis of Design)
2. GMC Roofing.
3. Or equal.

B. Zinc-Coated (Galvanized) Steel Accessories: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Stockton Products. (Basis of Design)
2. Fry Reglet Corp.
3. Alabama Metal Industries Corporation (AMICO).
4. California Expanded Metal Products Company (CEMCO).
5. Dietrich Industries, Inc.
6. Brand X Metals.
7. Or equal.

C. Architectural EPS Shapes:
1. Foam Concepts, VEFO Inc.
2. Foam Design Center.
3. Or equal.

D. Aluminum Trim and Reveals: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Fry Reglet Corp. (Basis of Design)
2. Flannery, Inc.
3. Gordon, Inc.
4. Pittcon Industries.

5. Brand X Metals, Inc.
6. Or equal.

2.2 MATERIALS

A. Factory Mixed Scratch and Brown Coat:
   1. Portland Cement: ASTM C 150, Type I or II.
   2. Sand Aggregate: ASTM C 897.
   3. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
   4. Admixture: Admix 500.

B. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.
   1. Product: Omegaflex by Omega or equal.
   2. Finish texture: Fine sand float finish acceptable to Architect.
   3. Color: As selected by Architect from manufacturer's full range.

C. Field painted finish: Comply with Division 9 Section “Painting”.

2.3 METAL LATH

A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653, G90, hot-dip galvanized zinc coating.
   1. Diamond-Mesh Lath: Self-furring.
      a. Weight: 3.4 lb/sq. yd.
      b. Use: Vertical and horizontal solid support surfaces, such as unit masonry, concrete, or sheathing. Horizontal open framing up to 16 inches on center.
   2. Diamond-Mesh Lath: Non-self-furring.
      a. Weight: 3.4 lb/sq. yd.
      b. Use: Attached with fastener when enforcing authority prohibit use of self-furring types.
   3. 3/8-Inch Rib Lath (High Rib):
      a. Weight: 3.4 lb/sq. yd.
      b. Use: Horizontal open framing 24 inches on center.

B. Wire Lath: ES Report, ESR-2017, ASTM C847 with ASTM A641, Class 1 galvanized coating, by Structa Wire or equal.
   1. Mega Lath: Self-furring.
      a. Weight: 1.95 lb/sq. yd.
      b. Use: Vertical and horizontal solid support surfaces.
   2. V Truss Wall & Ceiling Lath : Rib Lath
      a. Weight: 1.95 lb/sq. yd.
      b. Use: Vertical and horizontal open framing.

2.4 WEATHER-RESISTANT BARRIER

A. First Layer: Hydrotex by Fortifiber or equal.
   1. Description: Blended Super Jumbo Tex 60 Minute asphalt-saturated kraft paper with a drainable polymeric housewrap layer – packaged in a single roll.
   2. ICC Evaluation Service Report 1027.
   3. Tested Data:
      a. Moisture Vapor Transmission: ASTM E-96 Procedure A (Desiccant Method); 49.8 g/sm/day (7.6 perms).

B. Second Layer: Super Jumbo Tex 60 by Fortifiber or equal.
   1. Asphalt saturated paper weighing 56 lbs. per 1,000 square feet, having tensile strength of 89 lbs. and 60-minute water resistance rating.

2.5 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Zinc-Coated (Galvanized) Steel Accessories: Fabricated from hot-dip galvanized steel sheet, ASTM A 653 G90 zinc coating.
   1. Foundation Weep Screed.
   2. Cornerite: Fabricated.
   3. External-Corner Reinforcement.
   4. Cornerbeads.
      a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
      b. Small nose cornerbead with perforated flanges; use on curved corners.
      c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.
      d. Bull nose cornerbead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.
   5. Casing Beads: Square-edged style; with expanded flanges.
   6. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
   7. Expansion Joints: Folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
      a. Internal Corners: Double-V, narrow reveal type ("No. 30").
   8. Two-Piece Expansion Joints: Formed to produce slip-joint and square-edged reveal that is adjustable from 1/4-to-5/8-inch wide; with perforated flanges.
   9. Stucco Reglet:
      a. Product: “ST” Stucco Reglet by Fry Reglet.
      b. Thickness: 24 gage.
   10. Surface Mounted Reglet:
      a. Product: “SM” Surface Mount Reglet by Fry Reglet.
      b. Thickness: 24 gage.
   11. Flashing System:
      a. Product: Springlok Flashing System by Fry Reglet.
      b. Thickness: 24 gage.
   12. Termination Screed: J Mold.
      a. Product: J-B Bead by Stockton Products.

b. Size: As indicated on Drawings.

13. Window /Door Drip: Door Drip Screed.
    a. Product: WTP Window Termination Point by Stockton Products.
    b. Size: As indicated on Drawings.
14. Drip Screed: Stucco Drip Soffit.
    a. Product: NFD #5 Drip by Stockton Products.
    b. Size: As indicated on Drawings.

C. Aluminum Trim and Reveals:
1. Aluminum shall be extruded alloy 6063 T5, with clear anodized finish.
    a. Size: As indicated on Drawings.

D. Architectural EPS Shapes:
1. Product: STYRO-loc system by Foam Concepts, VEFO Inc. or equal.
2. Shapes: As indicated on Drawings.
3. Components:
    a. STYRO-loc: 24 gauge metal insert placed a minimum of 2.5 inches from end of Architectural EPS Shape
    b. Metal Cap: Minimum 24 gauge galvanized sheet metal
    c. Metal Straps: Minimum 2 inches x 16 gauge galvanized sheet metal placed a maximum of 24 inches on center
    d. Adhesives and Base Coat: As recommended by foam manufacturer.
4. Performance Requirements:
    a. Negative Uniform Load Testing: Ultimate failure shall not occur under 59 psf.
    b. Pull Out Capacity of Metal Insert: When loaded from a minimum of 12 inches from any end shall ultimately fail at no less than 227 pounds, and no less than 88 pounds when loaded at 1- inch from the end.
    c. Vertical Load Testing: Ultimate failure on 12” shape shall not occur under 3200 lbs. at edges and 6330 lbs. at the interior location.
    d. Structural Performance Test: Ultimate failure on 24” Shape shall not occur under 2963 lbs. at edges and 3181 at the interior location.
    e. Fire Performance Test: Necessary to sustain conditions of acceptance as described in the ICC –ES Acceptance criteria for Foam Plastic (Section 4.7).
    f. ESR Report: ESR-1823.

2.6 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063 and CBC Section 2507.
1. Nails, screws, and staples as specified in CBC.
2. Fastener for use with concrete/masonry for attaching lath and screeds/control joints, weeps and other shapes.
3. Wood Stud Applications: Galvanized steel furring nails and or screws, of type and length suitable for at least a 5/8 inch penetration of the wood stud system.

C. Sheathing: Comply with requirements of Division 6 Section “Sheathing”.

D. Isolation Strip at Exterior Walls: Comply with requirements of Division 7 Section “Flexible Sheet Flashing” for flashing windows, door, and other openings.

E. Thermal Insulation: Comply with requirements of Division 7 Section “Building Insulation”.

F. Acoustical Sealant for Exposed and Concealed Joints: Comply with requirements of Division 7 Section “Joint Sealants”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid-plaster bases that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.3 INSTALLATION, GENERAL

A. Thermal Insulation: As specified in Division 7 Section “Building Insulation”.

B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

C. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.4 INSTALLING METAL LATH AND WEATHER-RESISTANT BARRIER INSTALLATION

A. Comply with CBC 2507.3 Lath attachment to horizontal wood supports (DSA-SS, DSA-SS/CC).
   1. Where interior or exterior lath is attached to horizontal wood supports, either of the following attachments shall be used in addition to the methods of attachment described in referenced standards listed in Table 2507.2.
      a. Secure lath to alternate supports with ties consisting of a double strand of No. 18 W & M gage galvanized annealed wire at one edge of each sheet of lath. Wire ties shall be installed not less than 3 inches back from the edge of each sheet and shall be looped around stripping, or attached to an 8d common wire nail driven into each side of the joist 2 inches above the bottom of the joist or to each end of a 16d common

wire nail driven horizontally through the joist 2 inches above the bottom of the joist and the end of the wire secured together with three twists of wire.

b. Secure lath to each support with 1/2 inch wide, 1-1/2 inch long No. 9 W & M gage, ring shank, hook staple placed around a 10d common nail laid flat under the surface of the lath not more than 3 inches from edge of each sheet. Such staples may be placed over ribs of 3/8 inch rib lath or over back wire of welded wire fabric or other approved lath, omitting the 10d nails.

B. General: Comply with requirements of Title 24.
1. Use of self-furring lath is subject to satisfactory jobsite demonstration for each project of lath installation, with approval by Inspector of Record.

C. Expanded-Metal Lath: Install according to ASTM C 1063.
1. Lath shall be attached to framing members at spacing of not more than 6 inches o.c., 2 inches maximum from longitudinal edges, in accordance with CBC.
2. Lath shall not be continuous through control joints but shall be stopped and tied at each side per ASTM C1063, 7.10.1.4.

D. Weather-Resistant Barrier: Install 2 layers over sheathing.

3.5 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:
1. Install lath-type external-corner reinforcement at exterior locations.

C. Weep screed: Install at foundation plate line on all exterior stud walls per CBC 2512.1.2.
1. Minimum 4 inches above earth.
2. Minimum 2 inches above paved areas.

D. Control Joints: Install control joints in specific locations approved by Architect for visual effect as follows:
1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
a. Vertical Surfaces: 144 sq. ft.
b. Horizontal and other Nonvertical Surfaces: 100 sq. ft.
2. At distances between control joints of not greater than 18 feet o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.6 PLASTER APPLICATION

A. General: Comply with ASTM C 926.
1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.

2. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least 6 inches at each jamb anchor.
3. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
4. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Three-Coat System: Total minimum thickness of 7/8 inch for lathing base per CBC Table 25A-F.
1. Scratch Coat:
   a. Over Lathing Base: Apply scratch coat to a minimum thickness of 3/8 inch on vertical surface, and 1/4 inch on horizontal surface, using sufficient trowel pressure to key plaster into lath or to create bond to substrates as applicable. Prior to initial set, scratch horizontally to provide key for bond of brown coat.
2. Brown Coat: Apply brown coat to a minimum thickness of 3/8 inch on vertical surface, and 1/4 inch on horizontal surface, using sufficient trowel pressure to insure tight contact with scratch coat.
   a. Rod surface to screeds creating true and even plane.
   b. Trowel to a sand float finish and uniform surface to receive finish coat.
   c. Tool brown coat to provide a V-joint at intersection of plaster with frames or other item of wood, or metal.
3. Leveling and Reinforcing Coat:
   a. Allow Scratch & Brown Stucco Base to set and moist cure a minimum of 48 hours and allow to dry before applying the leveling and reinforcing coat.
   b. Using a stainless steel trowel, apply the Stucco Level Coat over Stucco Base at a thickness of 1/16 – 3/32 in.
   c. Fully embed the reinforcing mesh into the wet Stucco Level Coat including diagonal strips at corners of openings and trowel smooth. If Standard Mesh is used, seams are overlapped 2-½ in, and if the Intermediate Mesh is used, seams are butted and covered by strips of Detail mesh.
4. Cement Finish Coat:
   a. Apply Stucco Finish according to product datasheet and application instructions.
   b. Protect LaHabra Finish Coats from inclement weather until completely dry and cured.

C. Curing Time: Comply with CBC, or longer as needed to insure compliance with manufacturer's recommendations for quality stucco installation.
1. Portland cement plaster:
   a. Minimum period moist curing:
      1) First Coat: 48 hours.
      2) Second Coat: 48 hours.
   b. Minimum interval between coats:
      1) First Coat: 48 hours.
      2) Second Coat: 7 days.

3.7 ASSEMBLY

A. Exterior Side from framing out:
   1. Sheathing.
   2. Weather-Resistive Barriers.
   3. Metal Lath.
   4. Portland cement plaster system.

3.8 CUTTING AND PATCHING

A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.9 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.

B. Related Sections include the following:
   1. Division 9 Section "Tiling" for tile backer board installed as substrates for ceramic tile.
   2. Division 9 Section “Painting” for primers and finishes applied to gypsum board surfaces.

1.3 SUBMITTALS

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

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
   2. Finishes: Level 4 and 5 of gypsum board finish indicated for use in exposed locations. 4 by 4 foot sample.
      a. Finishes: For each finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
      b. Each finish indicated.
      c. Each areas such as walls, ceilings, and soffits.
   2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
   3. Simulate finished lighting conditions for review of mockups.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gypsum board that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Interior Gypsum Board: Subject to compliance with requirements, provide products by one of the following:
   1. Georgia Pacific. (District Standard)
   2. USG Corporation.
   3. National Gypsum Company.
   4. Or equal.

B. Steel Trim Accessories: Subject to compliance with requirements, provide products by one of the following:
   1. USG Corporation.
   2. Amico.
   3. Or equal.

2.2 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36 or ASTM C 1396, as applicable to type of gypsum board indicated and whichever is more stringent.

B. Type X:
   1. Thickness: 5/8 inch for new work.
   2. Long Edges: Tapered.
   3. Products:
      a. Toughrock Fireguard X by Georgia Pacific.
      b. Type X by USG.
      c. Or equal.

C. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
   1. Core: 5/8 inch, Type X.
   2. Use: Toilet rooms and janitor's closets walls with painted finish.
      a. DensArmor Interior Guard by Georgia Pacific.
      b. USG Mold Tough Firecode Core Gypsum Panels by USG.
      c. XP Wallboard by National Gypsum.
      d. Or equal.

D. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.
   1. Core: 5/8 inch, Type X.
   2. Long Edges: Tapered.
   3. Products:
      a. ToughRock Mold Guard by Georgia Pacific.
      b. Mold Tough Abuse-Resistant Gypsum Panels by USG.
      c. Hi-Abuse XP Wallboard by National Gypsum.
      d. Or equal.

2.4 TRIM ACCESSORIES

A. Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.
      g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim and Reveal: As specified in Division 9 Section “Portland Cement Plaster”.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Sealants shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

C. Acoustical Sealant: Sheetrock Acoustical Sealant by USG or equal.
   1. Sealants shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

D. Thermal and Acoustical Insulation: As specified in Division 7 Section "Building Insulation."

E. Gypsum Board Adhesives:
   1. High performance latex-based construction adhesive designed for gypsum board applications.
   2. Adhesives shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.
   3. Products:
      a. Green Series SW-325 Shear & Drywall Adhesive by OSI.
      b. Drywall Adhesive GDWA by Grabberman.
      c. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

3.3 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners, unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges.
   3. L-Bead: Use where indicated.

4. U-Bead: Use at exposed panel edges.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.4 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Comply with GA 214 for Level definitions.
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for ceramic tile or acoustical tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view with flat paint finish.
   a. Primer and its application to surfaces are specified in other Division 9 Sections.
5. Level 5: At panel surfaces that will be exposed to view with non-flat paint finish.
   a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.5 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Replace tiles to match existing.
   2. Cementitious backer units installed as part of tile installations.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
   1. Propose locations of expansion, contraction, control, and isolation joints if not indicated on Drawings.

C. Installation Method: Show TCA installation method number for each tiled area in tabulated form.

D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Qualification Data: For Installer.

G. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
   1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of ceramic tile and accessories that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years.

B. Installer’s Warranty: 1 year.

1.9 EXTRA MATERIALS

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

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tiles: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Daltile; Div. of Dal-Tile International Inc.
2. American Olean.
3. Crossville Ceramics Company, L.P.
4. Interceramic.
5. Bedrosians.
6. Emser Tile.
7. Or equal.

B. Setting, Grouting Materials: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Custom Building Products.
2. LATICRETE International Inc.
3. MAPEI Corporation.
4. Sienna.
5. Tec by H.B. Fuller.
6. Or equal.

C. Sheet Waterproofing for Tile Installation: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Schluter; DITRA-XL.
2. Noble Company (The); Nobleseal TS.
3. MAPEI Corporation.
4. Or equal.

D. Cementitious Backer Board: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. USG Corporation; DUROCK Cement Board.
2. National Gypsum Company; PermaBase.
3. C-Cure; C-Cure Board 990.
4. Custom Building Products; Wonderboard.
5. Or equal.

E. Metal Edge Strips and Transitions: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Schluter Systems (Basis of Design).
2. Blanke.
3. Or equal.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

C. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

2.4 UNCOUPLING AND WATERPROOFING FOR TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.10.

B. Product: Ditra XL System by Schluter or equal.
   1. Description: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on underside; 5/16-inch nominal thickness.
   2. Accessories:
      a. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness. Kerdi-Band and Kerdi-Flex by Schluter or equal.

2.5 SETTING AND GROUTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
   1. Prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive.
      a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
   2. Products:
      a. MAPEI: Ultraflex 2, Walls: MAPEI Ultralite.
      b. 254 Platinum by Laticrete.
      c. Custom Building Products: MegaFlex.
      d. Or equal.

B. Chemical-Resistant, Water-Cleanable, Grouting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.

2. Products:
   a. MAPEI: Kerapoxy IEG.
   b. SpectraLock Pro by Laticrete.
   c. Custom Building Products: 100% Solids Epoxy Grout.
   d. Or equal.

2.6 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."
   1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.7 TILE BACKER UNITS

A. Cementitious Back Units:
   1. Aggregated portland cement board with coated glass-mesh reinforcement scrim.
   2. Comply with ANSI A118.9.
   3. Pass ASTM E136 for non-combustibility.
   4. Thickness: As indicated on Drawings.
   5. Lengths: Maximum lengths available to minimize end-to-end butt joints.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
      a. Sub-floor and Vertical Surfaces: 1/4 inch in 10 feet.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
   1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
   2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.

G. Grout tile to comply with requirements of the following tile installation standards:
   1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 WATERPROOFING INSTALLATION

A. Do not install tile over waterproofing until waterproofing has been tested to determine that it is watertight.

3.6 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

B. Joint Widths: 1/16 inch unless specified otherwise.

3.7 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove epoxy grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.9 WALL TILE INSTALLATION, TCNA ASSEMBLY

A. Tile Installation: Interior wall installation over cementitious backer units; thin-set mortar; TCA W244C-07 with epoxy grout and ANSI A108.5.
   1. Mortar: Latex-portland cement mortar.
   2. Grout: Chemical-resistant, water-cleanable, tile-grouting epoxy.

3.10 FLOOR TILE INSTALLATION, TCNA ASSEMBLY

A. Tile Installation: Interior floor installation on waterproof membrane over concrete; thin-set mortar; TCNA F122 and ANSI A108.5.
   1. Mortar: Latex-portland cement mortar.
   2. Grout: Chemical-resistant, water-cleanable, tile-grouting epoxy.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes acoustical panels and suspension systems for ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SYSTEM DESCRIPTION

A. DSA Interpretation of Regulations (IR) Document Metal Suspension Systems for Lay In Panel Ceilings (IR25-2.13).
   1. Applies to ceiling systems whose total weight, including air conditioning grilles and light fixtures, does not exceed four (4) psf. Heavier systems and those supporting lateral loads from partitions will require special design details.
   2. 12 ga. minimum hanger wires may be used for up to and including 4'-0" x 4'-0" grid spacing and shall be attached to main runners.
   3. Provide 12 ga. hanger wires at the ends of all main and cross runners within eight inches of the support or within 1/4 of the length of the end tee, whichever is least, for the perimeter of the ceiling area. End connections for runners which are designed and detailed to resist the applied vertical and horizontal forces may be used in lieu of the 12 ga. Hanger wires, subject to Division of the State Architect (DSA) review and approval.
   4. Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits or discontinuous areas. Hanger wires that are more than 1 in 6 out of plumb are to have countersloping wires.
   5. Ceiling grid members may be attached to not more than 2 adjacent walls. Ceiling grid members shall be at least 3/4 inch free of other walls. If walls run diagonally to ceiling grid

system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.

6. At the perimeter of the ceiling area where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal strut or a 16 ga. wire with a positive mechanical connection to the runner may be used. Where the perpendicular distance from the wall to the first parallel runner is 12 inch or less, this interlock is not required.
7. Provide bracing assemblies consisting of a compression strut and four 12 ga. Splayed bracing wires oriented 90 degrees from each other (see Figure 1) at the following spacing:
    a. For school buildings, place bracing assemblies at a spacing not more than 12 by 12 feet on center.
    b. For Essential Services Buildings, place bracing assemblies not more than 8 by 12 feet on center.
    c. Provide bracing assemblies at locations not more than 1/2 the spacings given above, from each perimeter wall and at the edge of vertical ceiling offsets. The slope of these wires shall not exceed 45 degrees from the plane of the ceiling and shall be taut. Splices in bracing wires are not to be permitted without special DSA approval.
    d. Suspended acoustical ceiling systems with a ceiling area of 144 square feet or less, and fire rated suspended acoustical ceiling systems with a ceiling area of 96 square feet or less, surrounded by walls which connect directly to the structure above, do not require bracing assemblies when attached to two adjacent walls.
8. Fasten hanger wires with not less than 3 tight turns. Fasten bracing wires with 4 tight turns. Make all tight turns within a distance of 1-1/2 inches. Hanger or bracing wire anchors to the structure should be installed in such a manner that the direction of the wire aligns as closely as possible with the direction of the forces acting on the wire.
    a. Wire turns made by machine where both strands have been deformed or bent in wrapping can waive the 1-1/2 inch requirement, but the number of turns should be maintained, and be as tight as possible.
9. Separate all ceiling hanging and bracing wires at least 6 inches from all unbraced ducts, pipes, conduit, etc. It is acceptable to attach lightweight items, such as single electrical conduit not exceeding 3/4 inch nominal diameter, to hanger wires using connectors acceptable to DSA.
10. When drilled-in concrete anchors or shot-in anchors are used in reinforced concrete for hanger wires, 1 out of 10 must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 must be field tested for 440 lbs. in tension. Shot-in anchors in concrete are not permitted for bracing wires. If any shot-in or drilled-in anchor fails.
    a. Drilled-in or shot-in anchors require special DSA approval when used in prestressed concrete.
11. Attach all light fixtures and ceiling mounted air terminals or services, to the ceiling grid runners to resist a horizontal force equal to the weight of the fixtures. Screws or approved fasteners are required.
12. Flush or recessed light fixtures weighing less than 56 lbs., and air terminals or services, weighing less than 20 lbs may be supported directly on the runners of a heavy duty grid system but, in addition, they must have a minimum of two 12 ga. slack safety wires attached to the fixture at diagonal corners and anchored to the structure above. All 4 x 4 feet light fixtures must have slack safety wires at each corner.
    a. All flush or recessed light fixtures weighing 56 lbs. and air terminals or services, weighing 20 lbs or more must be independently supported by not less than four (4)

taut 12 ga. wires each attached to the fixture and to the structure above regardless of the type of ceiling grid system used.

b. The 4 taut 12 ga. Wires including their attachment to the structure above must be capable of supporting 4 times the weight of the unit.

13. All fixtures and air terminals or services supported on intermediate duty grid systems must be independently supported by not less than 4 taut 12 ga. wires each attached to the fixture or terminal, and to the structure above.
14. Support surface mounted light fixtures by at least two positive devices which surround the ceiling runner and which are each supported from the structure above by a 12 ga. wire. Spring clips or clamps that connect only to the runner are not acceptable.
    a. Provide additional supports when light fixtures are 8’-0" or longer.
15. Support pendant mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting 4 times the weight of the fixture. A bracing assembly per Figure 1, is required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit horizontal forces.
16. Required notes on construction documents:
    a. Classification of ceiling grid is heavy duty.
    b. Manufacturer’s catalog number - main runner.
        1) DX-26 (USG), ICC-ES. ESR-1222.
        2) 7301 (Armstrong), ICC-ES, ESR-1308.
    c. Manufacturer’s catalog number - cross runner.
        1) DX424 or DX216 (USG), ICC-ES, ESR-1222.
        2) XL7341 4 ft cross tee and XL7328 2 ft cross tee (Armstrong), ICC-ES, ESR-1308.
    d. Manufacturer’s catalog number of detail for runner splice.
        1) Integral system (USG) ICC-ES, ESR-1222.
        2) Same as main runner, 7301. Mains connect together for compression/tension strength (Armstrong), ICC-ES, ESR-1308.

B. Structural Performance:
1. Heavy Duty Grid.
2. Minimum 3/4 inch clearance from grid end to wall.
3. Minimum 2 inch perimeter molding or tested 7/8 inch perimeter molding with BERC2 clip by Armstrong.
4. Grid must be attached on 2 adjacent walls, no attachment on other 2 walls.
5. Perimeter T ends tied together at perimeters on tees that are not attached to perimeter molding.
6. Partition attachment bracing is required to be independent from ceiling splay bracing.
7. Seismic separation joint required for areas greater than 2,500 sq. ft. (or full height partitions).
8. Rigid bracing required for ceiling elevation changes.
9. Interior suspended ceilings, soffits, and bulkheads: Maintain deflection of not more than L/360 of distance between supports.

1.5 SUBMITTALS

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

B. Samples for Initial Selection: For components with factory-applied color finishes.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

E. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

F. Maintenance Data: For finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
      a. Smoke-Developed Index: 450 or less.
      b. Flame-Spread Classification: CBC 803 and Table 803.11.
         1) Flame-Spread Rating: Class 1 (0-25).

D. Seismic Loads: Design and size components to withstand seismic loads in accordance with meeting the requirements of ASCE 7 Section 13.5.6.2 as modified by 2019 CBC Section 1617A.1.21.

E. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical panel ceilings that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

1.11 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
   2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
   3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Panels, Clouds, and Baffles: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.

1. Armstrong World Industries, Inc. (Basis of Design)
2. USG Interiors, Inc.
3. Hunter Douglas Architectural Products.
4. BPB- Celotex.
5. Tectum Inc.
6. Or equal.

B. Suspension Systems: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Armstrong World Industries, Inc. (Basis of Design)
2. USG Interiors, Inc.
3. Hunter Douglas Architectural Products.
4. BPB Celotex.
5. Chicago Metallic Corporation.
6. Or equal.

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Product: As indicated on Drawings.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Meeting the requirements of ASCE 7 Section 13.5.6.2 as modified by 2019 CBC Section 1617A.1.21.

D. Wire for Hangers and Ties: Meeting the requirements of ASCE 7 Section 13.5.6.2 as modified by 2019 CBC Section 1617A.1.21.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

L. Wall Moldings: Meeting the requirements of ASCE 7 Section 13.5.6.2 as modified by 2019 CBC Section 1617A.1.21.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; heavy-duty.
   1. Product: 7301 Prelude XL by Armstrong or equal.
      a. Profile: Tee; 15/16 inch wide face.
      b. Construction: Double web.
      c. Structural Classification: ASTM C 635 Heavy-Duty.
      d. Finish: Factory painted white.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
   1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.

2.7 ACOUSTICAL SEALANT

A. Comply with requirement of Division 7 “Joint Sealants”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. Install suspension system and panels in accordance with manufacturer’s written instructions.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes acoustical tiles for ceilings and the following:
   1. Direct attachment of tiles to substrates with adhesive to match existing.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light-Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

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

B. Samples for Initial Selection: For components with factory-applied color finishes.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
   2. Concealed Suspension System Members: 12-inch- long Sample of each type.
   3. Exposed Moldings and Trim: Set of 12-inch- long Samples of each type and color.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical tile ceiling.

E. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Tile: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:
1. Surface-Burning Characteristics: Provide acoustical tile with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
a. Smoke-Developed Index: 450 or less.
b. Flame-Spread Classification: CBC 802.2 and Table 8-A.
1) Flame-Spread Rating: Class 1 (0-25).

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand meeting the requirements of ASCE 7 Section 13.5.6.2 as modified by 2019 CBC Section 1617A.1.21.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical tiles and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical tile ceilings that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer's Warranty: 1 year.

1.10 EXTRA MATERIALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Tiles: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Armstrong World Industries, Inc.
   2. Rockfon.
   3. BPB USA.
   4. USG Interiors, Inc.
   5. Or equal.

2.2 ACOUSTICAL TILES, GENERAL

A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

D. Antimicrobial Fungicide Treatment: Provide acoustical tiles with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.3 ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING

A. Products: Match existing acoustical panels as approved by Architect.

2.4 MISCELLANEOUS MATERIALS

A. Tile Adhesive: Type recommended by tile manufacturer, bearing UL label for Class 0-25 flame spread.
   1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical tile ceilings.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Testing Substrates: Before installing adhesively applied tiles on wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, DIRECTLY ATTACHED ACOUSTICAL TILE CEILINGS

A. Adhesive Installation: Install acoustical tile by bonding to substrate, using amount of adhesive and procedure recommended in writing by tile manufacturer, CISCA Ceiling System Handbook and as follows:
   1. Remove loose dust from backs of tiles by brushing and prime them with a thin coat of adhesive.
   2. Install splines in joints between tiles; maintain level of bottom surface of tiles to a tolerance of 1/8 inch in 12 feet and not exceeding 1/4 inch cumulatively.
   3. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.
   4. Do not bend tile during installation. The "spring load" will cause the adhesive to release.

B. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.

C. Arrange directionally patterned acoustical tiles as follows:
   1. As indicated on reflected ceiling plans.

3.4 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Luxury Vinyl Tile (LVT).
   2. Resilient wall base and accessories.

B. Related Sections include the following:
   1. Division 7 Section “Concrete Moisture and Alkalinity Testing” for concrete surface testing.
   2. Division 7 Section “Concrete Moisture and Alkalinity Barrier” for concrete surface preparation.

1.3 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements for Resilient Flooring:
   1. Resilient Flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include concrete moisture and alkalinity limits.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification:
   1. Full-size units of each color and pattern of resilient floor tile required.
   2. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.

D. Maintenance Data: For resilient products to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.7 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of resilient floor tile that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   2. Resilient Wall Base and Accessories: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Luxury Vinyl Tile (LVT): Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Shaw Contract. (Basis of Design)
   2. Mohawk Group.
   3. Armstrong World Industries, Inc.
   4. Marley Flexco (USA), Inc.
   5. Roppe Corporation.
   6. Or equal.

B. Resilient Wall Base: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Burke. (Basis of Design)
   2. Tarkett. (Basis of Design)
   3. Johnsonite.
   4. Or equal.

2.2 LUXURY VINYL TILE (LVT)

A. Product: As indicated on Drawings.

2.3 RESILIENT WALL BASE

A. Products: As indicated on Drawings.

2.4 RESILIENT MOLDING ACCESSORY

A. Types:
   1. Reducer strip for resilient floor covering
   2. Joiner for tile and carpet.

B. Material: Rubber.

C. Profile and Dimensions: As indicated.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed resilient tile and

as recommended/ required by the manufacturer for warrantee acceptance or provided by resilient tile manufacturer for the type of carpet being installed.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. VCT and Asphalt Tile Adhesives: 50 g/L.
   b. Cove Base Adhesives: 50 g/L.
   c. Rubber Floor Adhesives: 60 g/L.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates:
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Independent moisture and alkalinity testing prior to installation of resilient flooring as specified in Division 7 Section “Concrete Moisture and Alkalinity Testing”.
   3. Provide barrier as specified in Division 7 Section “Concrete Moisture and Alkalinity Barrier” if test exceed floor covering limits.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
   1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
   2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.5 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.
      a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
   1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
      a. Use commercially available product acceptable to manufacturer.
   2. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096519

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Surface Preparation.
   2. Field application of paints, stains, varnishes, and other coatings.

1.3 SUBMITTALS

A. Product data - Submit product data sheets for each product.

B. Samples:
   1. Submit two painted samples, illustrating selected colors and textures for each color and systems selected with specified coats cascaded.
   2. Submit on suitable backing, 8x10 inch size.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Mockup two (2) area prior to purchasing paint.
   2. Mockup size: As indicated on Drawings.
   3. 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.
   4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

C. Environment Requirements:
   1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.
   2. Do not paint when there is a threat of rain within 24 hours or when surface or air temperatures are at or below 40 degrees.

1.7 WARRANTY

A. Installer Warranty: 1 year.

1.8 EXTRA STOCK

A. Provide following:
   1. Minimum 1 gallon each product in original or new 1 gallon cans.
      a. Color spot each lid.
      b. Identify with formula, location, product and date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Paints: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Sherwin Williams. (Basis of Design)
   2. PPG.
   3. Behr Paint.
   4. Kelly Moore.
   5. Dunn-Edwards.
   6. Vista Paint.
   7. Or equal.

2.2 PAINTS AND COATINGS

A. Ready mixed, except field-catalyzed coatings.

B. Prepare pigments:
   1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogenous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. Do not proceed unless substrate is suitable.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent
   3. Interior Wood: 15 percent, measured in accordance with ASTMD4442.
   4. Exterior Wood: 15 percent, measured in accordance with ASTMD4442.

3.2 PREPARATION OF SURFACE

A. General:
   1. Clean all exterior walls and surfaces of loose and scaly paint, dirt, dust, chalk, and other foreign matter by water-blasting using care not to damage substrate followed by hand scraping, sanding or wire brushing after surfaces are dry. Mildew must be treated with household bleach solution and rinsed thoroughly.
   2. Patch, caulk, set protruding nails and repair all surfaces and cracks where necessary with suitable patching materials and smooth off to match adjacent surfaces.
   3. Sand Glossy surfaces to dull surface and remove residue.
   4. Remove mildew from affected surfaces with a solution of Tri-Sodium Phosphate and bleach. Rinse with clean water and allow to dry completely.
   5. Existing surfaces to be recoated shall be thoroughly cleaned and de-glossed by sanding or other means prior to priming and painting. Patched and bare areas shall be spot primed with the same primer as specified for new work.
   6. Rusty metal: Scrape, sand or wire wheel, feathering edges to sound coating. Dust surfaces. Topcoat.
   7. Remove soil and body oils completely from surfaces, including handrails, door edges and posts. Treat with Liquid Sandpaper or Dull-N-Bond.
   8. Remove hardware, accessories, plates, fixtures and similar items not to be finished. Reinstall at completion.
   9. Signage and artwork shall be removed and reinstalled.

B. Concrete Surfaces:
   1. Concrete surfaces shall be dry, clean and free from efflorescence, encrustations and other foreign matter. Any glazed surface shall be slightly roughened or etched. Curing compounds, bond breakers, release agents and other coatings shall be removed with a light sandblast or high pressure power wash.

C. CMU Surfaces:
   1. Remove dirt, loose mortar, scale, powder and other foreign matter from concrete block surfaces which are to be painted.
   2. Unpainted CMU surfaces shall be cleaned with TSP. Rinse thoroughly. Surface shall be tested for adhesion. Prime as listed in materials section; allow to cure, then perform adhesion test with duct tape.

D. Galvanized Surfaces: Remove all oils and contamination from galvanized surfaces scheduled to be painted by washing with a compliant solvent wash.

E. Ferrous Metal: Remove grease, rust, scale, dirt and dust from ferrous metal surfaces. Primer coat shall be applied not less than 30 minutes, nor more than 3 hours after preparation of surface.

F. Primed Metal: Sand and scrape shop primed metal to remove loose primer and rust. Touch-up bare, abraded and damaged areas with metal primer. Feather edges to make touch-up patches inconspicuous.

G. Wood Surfaces:
   1. Remove dust, grit and foreign matter from wood surfaces. Sand surfaces and dust clean. Spot prime knots, pitch streaks and sappy sections with a stain blocking primer where surfaces are to be painted. Fill nail holes, cracks and other defects after priming and spot prime repairs after patching material has fully cured.
   2. Wood surfaces with peeling areas are to have edges of broken paint film sanded to a feather edge.
   3. Back prime wood trim. Paint tops, bottoms, edges and cut-outs of doors.

H. Plaster Surfaces:
   1. Plaster surfaces shall be dry and free from efflorescence, encrustations and foreign matter. Fill cracks, holes and imperfections, smoothing repairs to match adjacent texture. Allow repairs to fully cure before priming.
   2. Prime plaster surfaces with specified primer. Caulk all cracks.

I. Preparation of other surfaces shall be performed following specific recommendations of the coating manufacturer.

3.3 PREVIOUSLY COATED SURFACES

A. Maintenance painting will frequently not permit or require complete removal of all old coatings prior to repainting. However, all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers must be removed to assure sound bonding to the tightly adhering old paint. Glossy surfaces of old paint films must be clean and dull before repainting. Thorough washing with an abrasive cleanser will clean and dull in one operation, or, wash thoroughly and dull by sanding. Spot prime any bare areas with an

appropriate primer. Recognize that any surface preparation short of total removal of the old coating may compromise the service length of the system. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required per ASTM D4259.

3.4 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved

E. Sand wood surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust particles just prior to applying next coat.

G. Stipple all edges and corners to conceal brush marks.

H. Paint entire trim element with like color. Painting of faces only is unacceptable. Trim surfaces must be wrapped with the trim color and not "faced off" or "Hollywooded".

I. Doors: Paint entire door unless otherwise noted, including door top and bottom edge surfaces.

J. Tinting: Tint each primer a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint primer to match the color of the finish coat, but provide sufficient differences in shade of primer to distinguish each separate coat.

3.5 PROTECTION

A. Protect work of other trades and items not intended to receive paint. Install "wet paint" signs to protect newly painted surfaces.

3.6 CLEANING

A. Protection - Carefully protect areas where work is in progress from damage.
   1. Provide and spread clean drop cloths when and where required to provide the necessary protection.
   2. Immediately clean-up all accidental spatter, spillage, misplaced paint and restore the affected surface to its original condition.

B. Clean-up:

1. Clean up debris daily per OSHA requirements.
2. At completion of work, remove all materials, supplies, debris and rubbish and leave each area in a clean, acceptable condition.
3. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.7 SURFACES TO BE FINISHED

A. Paint all existing exterior finishes and areas affected by work, unless notes otherwise.

B. Do not paint or finish the following items:
1. Items fully factory-finished unless specifically noted.
2. Fire rating labels, equipment serial number and capacity labels.

C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
2. Paint shop primed items occurring in finished areas.

3.8 CRACK FILLERS

A. Crack Fillers: elastomeric coating manufacturers recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated; VOC content complying with limits of authorities having jurisdiction.

B. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated; VOC content complying with limits of authorities having jurisdiction.

3.9 Concrete Unit Masonry Block Filler: Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated; VOC content complying with limits of authorities having jurisdiction.

3.10 PAINT SYSTEMS - EXTERIOR

A. CMU, Latex Flat:
1. 1 Coat: Loxon Block Surfacer, LX01.
2. 2 Coats: A-100 Exterior Latex Flat, A6 Series.

B. Plaster/Stucco, Opaque, Flat, Latex, 3 coat:
1. 1 Coat: Loxon Masonry Primer LX01.
2. 2 Coats: A-100 Flat A6W851 (1.4 mils dft pr/ct).

C. Ferrous Metals, Unprimed, Latex, 3 coat:
1. 1 Coat: All Surface Enamel Primer LX02.
2. 2 Coats: PI WB Alkyd Urethane Semi-Gloss B53.

D. Galvanized Metals, Semi-Gloss, Waterbased Alkyd, 3 coat:
   1. 1 Coat: Pro-Cryl Universal Primer B66-310.
   2. 2 Coats PI WB Alkyd Urethane Semi-Gloss B53.

E. Wood and Composite Wood, Flat, Opaque, Latex, 3 coat:
   1. 1 Coat: A-100 Exterior Latex Primer B42W41.
   2. 2 Coats: A-100 Flat A6W851.

F. Wood and Composite Wood, Semi-Gloss, Opaque, Latex, 3 coat
   1. 1 Coat: A-100 Exterior Latex Primer B42W41.
   2. 2 Coats: PI WB Alkyd Urethane Semi-Gloss B53.

3.11 PAINT SYSTEMS -INTERIOR (NO VOC)

A. Gypsum Board, Latex Egg-Shell:
   1. 1 Coat: ProMar 200 Interior Latex Primer B28W2600.
   2. 2 Coats: ProMar 200 Interior Latex Egg-Shell B20-2600 Series.

B. Gypsum Board, Acrylic Semi-Gloss Enamel:
   1. 1 Coat: ProMar 200 Interior Latex Primer B28W2600.
   2. 2 Coats: ProMar 200 Interior Semi-Gloss B31-2600 Series.

C. Masonry, Latex Egg-Shell:
   1. 1 Coat: ProMar 200 Interior Latex Primer B28W2600.
   2. 2 Coats: ProMar 200 Interior Latex Egg-Shell B20-2600 Series.

D. Wood, Composition Board, Latex Egg-Shell:
   1. 1 Coat: ProMar 200 Interior Latex Primer B28W2600.
   2. 2 Coats: ProMar 200 Interior Latex Egg-Shell B20-2600 Series.

E. Wood, Acrylic Semi-Gloss Enamel:
   1. 1 Coat: ProMar 200 Interior Latex Primer B28W2600.
   2. 2 Coats: Pro Industrial Water base Alkyd Urethane Semi-Gloss B53 Series.

F. Metal - Steel, Aluminum, Galvanized, Acrylic Semi-Gloss Enamel:
   1. 1 Coat: Pro Industrial ProCryl Primer B66-310 Series.
   2. 2 Coats: Pro Industrial Water base Alkyd Urethane Semi-Gloss B53 Series.

3.12 COLORS

A. To be selected by Architect from manufacturer’s full range of colors.

END OF SECTION 099100

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Markerboards.
   2. Tackboards.
   3. Teaching wall – Sliding Markerboards.

1.3 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Show location of panel joints.
   2. Show location of special-purpose graphics for visual display surfaces.
   3. Include sections of typical trim members.

C. Schedule: List product, size, and type by room numbers.

D. Samples for Initial Selection: For each type of visual display surface indicated and as follows:
   1. Actual sections of face sheet and tack assembly.
   2. Samples of accessories involving color selection.

E. Samples for Verification: For each type of visual display surface indicated and as follows:
   1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
   2. Trim: 6-inch- long sections of each trim profile.
   3. Accessories: Full-size Sample of each type of accessory.

F. Maintenance Data: For visual display surfaces to include in maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display surfaces and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

B. Fire-Test-Response Characteristics: Provide fabrics with the surface-burning characteristics indicated, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
   2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.7 WARRANTY

A. Special Warranty for Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace face sheets that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Surfaces lose original writing and erasing qualities.
      b. Surfaces become slick or shiny.
      c. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: Life of the building.

B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Markerboard: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. LCS Markerboard by Claridge Products & Equipment, Inc. (Basis of Design).
2. 555 Series, P3 ceramic steel by Polyvision Corporation.
3. Magnaboard by Chatfield Clarke Co.
4. Modular Trim System by Platinum Visual Systems.
5. A-1 Visual Systems.
6. Best-Rite.
7. Or equal.

B. Tackboard: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Forbo. (Basis of Design)
2. Claridge Products & Equipment, Inc.
3. Tackboard by Polyvision Corporation.
4. Chatfield Clarke Co.
5. Modular Trim System by Platinum Visual Systems.
6. A-1 Visual Systems.
7. Platinum Visual Systems.
8. Or equal.

2.2 MARKERBOARDS

A. Product: Markerboard by Claridge Products & Equipment, Inc.
1. Face Sheet: 24 gauge, white.
   a. LCS-II, 75 low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.
2. Core Material: 7/16" MDF unless fire retardant materials are required, then provide 7/16 inch Duracore.
3. Panel Backing: Moisture barrier back; 0.002" Aluminum Foil Panel.
4. Metal Frame/Trim: Series #4, 5/8 inch trim face.
   a. Extruded aluminum, alloy 6063, clear anodized finish.
   b. Trim for three sides: Side trim with narrow leg exposed and mitered at corners.
   c. Chalk trough: Outer end corners rounded to approximately 1-1/2 inches radius.
5. Size: As indicated on Drawings.
6. Maprail: 74EZ, 2 inch.

2.3 TACK BOARD

A. Product: Bulletin Board by Forbo.
   1. Self-healing properties.
   2. Washable finish.
   3. Color: As indicated on Drawings.
   4. Low light-reflectance (no-glare)
   5. Anti-bactericidal properties.
   6. Resists cracking, drying & peeling.
   7. Frame: Satin anodized aluminum.
   8. Assembly: 1/4" burlap-backed Forbo laminated to 3/8" fiberboard.
   9. Complete with installation hardware.
   10. Fire Testing: Class B when tested in accordance to ASTME84/NFPA255, Standard Test Method for Surface Burning Characteristics.
   11. 10-year warranty.
   12. Size: As indicated on Drawings.

2.4 TEACHING WALL – SLIDING MARKERBOARDS

A. Custom as indicated on Drawings.

2.5 ACCESSORIES

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated.
   1. Factory-Applied Trim: Manufacturer's standard.

B. Chalktray: Manufacturer's standard, continuous.
   1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

C. Map Rail: Provide the following accessories:
   1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
   2. End Stops: Located at each end of map rail.
   3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of map rail or fraction thereof.
   4. Flag Holder: One for each room.

2.6 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards, unless otherwise indicated.
   1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
   1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
   2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
   3. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.
   1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.7 ALUMINUM FINISHES

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

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine walls and partitions for proper backing for visual display surfaces.

C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

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

3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation. Units shall be braced in place to allow curing of adhesive. There shall be no gaps or voids in adhesion and units shall not give when pushed.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

A. Visual Display Boards: Visual Display Boards shall be attached to the wall by spreading adhesive over the entire back of the panel with 1/4 inch notched trowel. Panels shall be braced to provide thorough adhesion to the substrate, and shall exhibit no “sponginess” when pressed.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Panel signs (room signs).
   2. Traffic signs.
   3. Signage accessories.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Raised characters shall comply with CBC Section 11B-703.2.:
      a. Depth: It shall be 1/32 inch (0.8 mm) minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
      b. Height: It shall be 5/8 inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter “I”. CBC Section 11B-703.2.5.
      c. Finish and contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1
      d. Proportions: It shall be selected from fonts where the width of the uppercase letter “O” is 60 % minimum and 110 % maximum of the height of the uppercase letter “I”. Stroke thickness of the uppercase letter “I” shall be 15 % maximum of the height of the character. CBC Sections 11B-703.2.4.
      e. Character Spacing: Spacing between individual tactile characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8.
      f. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed and rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
      g. Mounting height: A tactile sign shall be located 48” minimum to the baseline of the lowest Braille cells and 60” maximum to the baseline of the highest line of raised characters above the finish floor or ground surface.
      h. Mounting location: A tactile sign shall be located on the approach side, as one enters or exits rooms or space, and be reached within 0” of the required clear floor space per CBC Section and Figure 11B -703.4.2 as follows:
         1) a clear floor space of 18’ x 18” minimum, centered on the tactile characters, shall be provided beyond the arc of any door swings between the closed position and 45 degree open position.

2) on the wall at the latch side of a single door.
3) on the inactive leaf of a double door with one active leaf.
4) on the wall at the right side of a double door with two active leafs.
5) on the nearest adjacent wall where there is no wall space at the latch side of a single door or no space at the right side of a double door with two active leafs.

2. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40" minimum above finish floor or ground.
3. Pictograms shall comply with CBC Section 11B-703.6.
4. Symbol of accessibility shall comply with CBC Section 11B-703.7.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.

C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
1. Panel Signs: Full-size Samples of each type of sign required.
2. Approved samples will not be returned for installation into Project.

E. Qualification Data: For Installer.

F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of signage manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain each sign type through one source from a single manufacturer.

C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

D. All tactile signage must be field inspected after installation per CBC 11B-703.1.1.2.

1.6 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
   1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signage fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Signs: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Best Sign Systems Inc. (Basis of Design)
   2. Apco Graphics Inc.
   3. ASI Sign Systems, Inc.
   4. Curcio Enterprises, Inc.
   5. Mohawk Sign Systems.
   6. Sign A Rama.
   7. Or equal.

2.2 PANEL ROOM SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.

B. Product: HC300 ADA Sign System by Best Sign Systems.

1. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished.
2. No Smoking signs.
3. Room, Occupancy, Wayfinding Signs: As selected from 4 standard copy size signs.
   a. 4" x 2" with up to 4 characters each.
   b. 6" x 2" with up to 8 characters each.
   c. 8" x 2" with up to 12 characters each.
   d. 10" x 2" with up to 14 characters each.
4. Toilet Room Signs: As selected from manufacturer's standard.
5. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.
6. Material:
   a. 1/4 inch thick (thicker than standard) "MP", acrylic sheet, ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
7. Copy: Contracted grade 2 Braille all capital letter on tactile sign.
   a. Font and Size: As indicated on Drawings.

2.3 PARKING SIGNS

A. Material: 0.063" aluminum, screen printed copy on engineer grade reflective vinyl sheeting.
   1. Text: Symbols of accessibility, accessible direction, etc. as indicated on Drawings.

B. Accessible signs are blue with white symbol.

C. Post: 2 inch diameter, schedule 40 galvanized pipe.

2.4 TRAFFIC SIGNS

A. Material: 0.080" aluminum, screen printed copy on engineer grade reflective vinyl sheeting.
   1. Text: Stop, Yield, Do Not Enter, etc. as indicated on Drawings.

B. Post: 2 inch diameter, schedule 40 galvanized pipe.

2.5 ACCESSORIES

A. Mounting Methods: Use concealed fasteners fabricated from materials that are not corrosive to sign material and mounting surface.

B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.6 FINISHES, GENERAL

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

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.

C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

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

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
   1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
   2. Signs placed on glazed surfaces, backing sign of the same material and color shall be applied on the opposite glazed surface.

B. Wall-Mounted Panel Signs:
   1. Interior Signs on Smooth Substrates:
      a. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.
   2. Exterior and Interior Signs on Rough Substrates:
      a. Mechanical Fasteners: Mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

1) Fastener: Stainless steel screws, tamper-resistant flat head countersink.
2) Anchors: Suitable for secure attachment to substrate.

C. Parking and Traffic Signs
1. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
2. Install sign level, plumb, and at height indicated.
3. Cap post with galvanized cap.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by District.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes solid-polymer units as follows:
   1. Toilet Enclosures.

B. Related Sections include the following:
   1. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Accessible Toilet Compartments:
   1. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.
   2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9” high minimum above the finish floor and 6” deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12” high minimum above the finish floor for children’s use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66” wide.
   3. An ambulatory accessible compartment shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more per CBC Section 11B-213.3.1. Such compartment shall comply with CBC Section 11B-604.8.2.
   4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that pull-side clearance for ambulatory accessible compartments shall be minimum 44” clear, rather than 60”. CBC Figure 11B-604.8.2.
   5. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.
   6. Doors shall not swing into clear floor space or clearance required for any fixtures.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of cutouts for compartment-mounted toilet accessories.
   2. Show locations of reinforcements for compartment-mounted grab bars.

C. Samples for Initial Selection: For each type of unit indicated.

D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of toilet compartments that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 15 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Solid-Polymer Units: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Hiny Hiders – Scranton/Santana/Comtec. (Basis of Design)
   2. Bradley.
   3. Global Materials.
   4. Ampco.
   5. Or equal.

2.2 MATERIALS

A. Solid-Polymer:
   1. Self Ignition: 700 F, ASTM D1929.
   2. Rate of Burn: 1.29 cm/min., ASTM D635.
   3. Smoke Density: 13.9, ASTM D2843.

B. Aluminum: 6364-T5 aluminum extrusions, ASTM B221.

2.3 SOLID-POLYMER UNITS

A. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
   1. HDPE, must be tested in accordance with NFPA 286, CBC 803.9 & 803.1.1

2.4 COMPONENTS

A. Wall and Pilaster Brackets: 54-inch long, continuous plastic channel brackets.

B. Pilaster Shoes:
   1. Manufacturer's stainless steel.

C. Fasteners: "The Clean Look" 3/4 inch #14 screws (Star-Head Security Pin).

D. Brackets: Plastic Continuous.

E. Hardware:
   1. Hinge Type: Wrap-around, Aluminum.
   2. Door latch housing: Aluminum extrusion with clear anodized finish, surface mounted fastened to door with Type 304 stainless steel vandal resistant one-way screws. Side bolt and button shall be "Tough coat black" finish. Thumb turn type not acceptable in order to meet Accessibility code.
   3. Strike and keeper: 6-inch long extruded aluminum with clear anodized finish, equipped with rubber bumper, fastened to pilaster with vandal resistant one-way through bolts.
   4. Equip each door with sliding door latch and coat hook with bumper.
   5. Provide door pull and wall stop for outswing doors. Equip Accessible stall doors with inside and outside pulls.
      a. Door Pull: U shape.
   6. Hinge Inswing: Standard position closed.
   7. Hinge Outswing: Standard position closed.
   8. Hinge Accessible: Standard position closed.

2.5 FABRICATION

A. Fabricate partitions with finished faces, free of saw marks, and edges machined to 0.250 inch radius.

B. Bevel corners and edges of cutouts.

C. Doors, Panels, Pilaster, and Urinal Screens:
1. Thickness: 1 inch minimum.
2. Door Width:
a. 24 inches minimum.
b. Accessible type:
1) Front Access to Compartment: 32 inches minimum clear opening.
2) Side Access to Compartment: 34 inches minimum clear opening.
3. Door Height: 55 inches.
4. Pilaster Height: 82 inches.
5. Panel Height: 55 inches, mounted 14 inches AFF.
6. Heat-Sink Strip: Aluminum edging strips to be fastened to bottom edge of doors and panel using anti-theft fasteners.

D. Urinal Screens:
1. Thickness: 1 inch.
2. Screen Width: 24 inches minimum.
3. Screen Height: 42 inches mounted 14 inches AFF.
4. Heat-Sink Strip: Aluminum edging strips to be fastened to bottom edge of doors and panel using anti-theft fasteners.

2.6 FINISHES

A. Solid, high-density polyethylene:
1. Color: As selected by Architect from manufacturer’s full range**.**

B. Aluminum: Clear anodized.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.
2. Attach continuous wall brackets securely to walls using stainless steel fasteners spaced maximum 12 inches on center.
3. Attach panels and pilasters to continuous brackets with one-way sex bolts.

B. Floor to Ceiling Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

C. Floor to Ceiling Anchored Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ERECTION TOLERANCES

A. Maximum variation from true position: 1/4 inch. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 1/4 inch.

B. Maximum variation from plumb: 1/8 inch.

3.3 ADJUSTING

A. Hardware Adjustment:
   1. Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation.
   2. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched.
   3. Set hinges all accessible stalls to return to fully closed position.

END OF SECTION 102113

SECTION 102213 - WIRE MESH PARTITIONS

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. Wire mesh partitions.
   2. Wire mesh ceilings
   3. Swing Doors.

B. Related Sections:
   1. Division 8 Section “Door Hardware” for door hardware.
   2. Division 9 Section "Painting" for touch-up painting of factory coated finishes.

1.3 DEFINITIONS

A. As defined in ASTM E 2016:
   1. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
   2. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Wire mesh units shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7:
   1. Seismic Loads: As indicated on Drawings.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wire mesh items.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include clearances required for operation of doors.

C. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Qualification Data: For qualified Installer.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain wire mesh items from single source from single manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped crated to provide protection during transit and Project-site storage. Use vented plastic.

B. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.
   1. Tag each item or package separately with identification and include basic installation instructions with each item or package.

C. Deliver keys to Owner.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Door Locks: Equal to 5 percent of amount installed for each type indicated, but no fewer than 3 locks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wire Mesh Partitions: 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. Wirecrafters. (Basis of Design)
   2. Saferack.
   3. The G-S Company.
   4. California Wire Products Corporation.
   5. Acorn Wire & Iron Works, Inc.
   6. Folding Guard Corporation.
   7. King Wire Partitions, Inc.
   8. Or equal.

2.2 WIREMESH PARTITIONS

A. Product: Style 840 Wire Partitions with Ceilings by Wirecrafters or equal.
   1. Panels:
      a. 10gauge steel wire crimped and woven in to 2" x 1" opening rectangular mesh, securely welded into a frame of 1 1/4" x 1 1/4" x 1/8" steel angle factory punched with 7/8" x 7/16" slotted holes to accept 3/8" mounting hardware.
      b. Panels four to six feet wide shall have one 1/4" x 3/4" flat stiffener, wider panels receive two 1/4" x 3/4" stiffeners.
      c. All panels shall be fastened to posts with 3/8" x 3" plated bolts and nuts.
   2. Hinged Doors:
      a. Constructed of the same materials as the panels with two 1/4" x 3/4" horizontal stiffeners across the width, and two diagonal 1/4" x 3/4" stiffeners from center to the corner.
      b. Hinged doors shall be equipped with padlock lugs (cylinder lock optional), three 4" x 4" spun pin hinges, and pick plate/slam bar assembly.
   3. Posts:
      a. Made of 2" x 2" x 14 gauge steel tubing. Base plates of 2" x 7" x 1/4" steel flat with two 7/16" round holes for anchoring, shall be welded to each tube.
      b. Posts are factory drilled with 1/2" holes to accept hardware for mounting panels.
   4. Hardware:
      a. 3/8 inch standard thread grade two plated nuts and bolts. Floor anchors are 3/8" wedge type-provided.
   5. Finish:
      a. Non-plated parts receive one coat of gray acrylic enamel. Touch up paint included with each shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

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

3.2 WIRE MESH PARTITIONS ERECTION

A. Anchor wire mesh partitions to floor with 3/8-inch- diameter, postinstalled expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
   1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.
   3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
   4. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
   5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

C. Secure top capping bars to top framing channels with 1/4-inch- diameter "U" bolts spaced not more than 28 inches o.c.

D. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

E. Install doors complete with door hardware.

F. Bolt accessories to wire mesh partition framing.

3.3 ADJUSTING AND CLEANING

A. Adjust doors, to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.

C. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 “painting” Sections.

END OF SECTION 102213

SECTION 102600 – WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Corner guards.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.

B. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated.
   1. Include similar Samples of accent strips and accessories involving color selection.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Wall Guards: 12 inches long. Include examples of joinery, corners, and field splices.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
   2. Warranty Period: 5 years.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Corner Guards: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Koroseal. (Basis of Design)
2. IPC Door and Wall Protection Systems; Division of InPro Corporation.
3. Construction Specialties (C/S), Inc.
4. Balco, Inc.
5. Pawling Corporation.
6. Or equal.

2.2 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.
1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

2.3 CORNER GUARDS

A. Product: Korogard GS Series Stainless Steel Corner Guard by Koroseal or equal.
1. Stainless Steel Corner Guards:
a. Stainless Steel 90°/90° Bullnose 3.5 inch.
b. Size: As indicated on Drawings.

2.4 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Remove tool and die marks and stretch lines or blend into finish.
2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
   2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
   1. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings.
   2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
      a. Provide anchoring devices to withstand imposed loads.
      b. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean covers.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:
   1. Toilet accessories.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Elements of Sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612.
   2. Grab bars in toilet facilities and bathing facilities shall comply with CBC Section 11B-609.
   3. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
      a. 1-1/2” between the grab bar and the wall.
      b. 1-1/2” minimum between the grab bar and projecting objects below and at the ends.
      c. 12” minimum between the grab bar and projecting objects above.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.
   4. Features that will be included for Project.
   5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

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

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace toilet and bath accessories that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer’s Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Toilet and Bath Accessories: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Bobrick Washroom Equipment, Inc. (Basis of Design)
   2. American Specialties, Inc.
   3. Bradley Corporation.
   4. Or equal.

B. Underlavatory Guards: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Handy-Shield by Plumberex Specialty Products, Inc. (Basis of Design)
   2. IPS Corp.
   3. TCI Products.
   4. Truebro, Inc.
   5. Or equal.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.

D. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 TOILET ACCESSORIES

A. As indicated on Drawings.

2.4 UNDERLAVATORY GUARDS

A. Product: Handy-Shield Maxx by Plumberex Specialty Products, Inc. or equal.
   1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
   2. PVC insulator shall be 1/8" thick.
   3. Meets Testing Standard ASTM E 84-07 per IBC Chapter 8.
      a. 25 flame spread.
      b. 450 smoke index.
   4. Surfaces to be soft, smooth, non-absorbent, easy to clean U/V inhibited, antimicrobial, antifungal properties.
   5. Insulator shall have a dual fastening system which consists of fusion bonded Velcro fastener strips for full slit enclosure and tamper resistant, smooth, non-abrasive snap-locking fasteners.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate OFCI items with District.

B. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104116 – EMERGENCY KEY CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Key storage cabinets.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of key storage cabinets that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Key Storage Cabinets: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Knox Company. (Basis of Design)
   2. Or equal.

2.2 KEY STORAGE CABINETS

A. Product: 3200 Series Knox-box by Knox or equal.
   1. Housing: 1/4 inch plate steel.
   2. Door: 1/2 inch thick steel door, stainless steel hinge.
   3. Capacity: Holds up to 10 keys or 3 access cards.

4. Grade: Exterior grade; resists moist conditions with weather resistant door gasket.
5. Dimensions:
   a. 5 inch W x 4 inch H x 3-1/4 inch D for surface mount.
6. Lock: 1/8 inch thick stainless steel dust cover with tamper seal. UL listed. Double-action rotating tumblers and hardened steel pins accessed by biased cut key.
7. Weight: 8 lbs for surface mount.
8. Finish: Factory Knox-coat, a proprietary powder coat.
   a. Color: As selected by Architect from black, dark bronze, or aluminum.
9. Installation Accessories: 5/16 inch Grade 5 or 8 bolt and large washers.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine walls for suitable conditions where cabinet will be installed.

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

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Install cabinet level, plumb, square, rigid, and true.

END OF SECTION 104116

SECTION 104400 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Portable fire extinguishers.
   2. Fire-protection cabinets for the following:
      a. Portable fire extinguishers.
   3. Mounting brackets for fire extinguishers.

1.3 SYSTEM DESCRIPTION

A. Fire Extinguisher Cabinets:
   1. Fire Extinguisher Cabinets must comply with CBC Sections 11B-307, 11B-308, 11B-309 and 11B-403.
   2. Fire Extinguisher Cabinets must comply with Title 19.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
   1. Fire Extinguishers: Include rating and classification.
   2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.

C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.
   1. Size: 6 by 6 inches square.

D. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10-1998 Edition, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.6 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: 6 years.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers and Cabinets: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. JL Industries, Inc. (Basis of Design)
   2. Larsen's Manufacturing Company.
   3. Potter Roemer; Div. of Smith Industries, Inc.
   4. Ansul.
   5. Or equal.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick minimum.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
   1. Valves: Manufacturer's standard.
   2. Handles and Levers: Manufacturer's standard.
   3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
   4. Certification Tag: Provide fire extinguisher with valid certification test tag where fire extinguishers are fully charged and ready to be used.

B. Dry Chemical Type: Cast steel tank, with pressure gage.
   1. Class 2A-10B:C, UL rated.
   2. Nominal Capacity: Provide largest capacity fire extinguisher that will fit in the cabinet, but 5 lbs. minimum.
   3. Finish: Baked enamel, red color.
   4. Use: General purpose.

C. Dry Chemical Type: Cast steel tank, with pressure gage.
   1. Class 2A-20B:C.
   2. Nominal Capacity: Provide largest capacity fire extinguisher but 10 lbs. minimum.
   3. Finish: Baked enamel, red color.
   4. Use: At mechanical rooms and where indicated.

D. Wet Chemical Type: Cast steel tank, pressurized, including hose and nozzle, with bracket.
   1. Class 2A-K.
   2. Size 2.5 gal.
   3. Finish: Factory baked enamel, red color.
   4. Use: At kitchens.

2.4 FIRE-PROTECTION CABINET

A. Product: Cosmopolitan series - stainless steel fire extinguisher cabinet by JL.
   1. Door and Trim Construction: No. 4 stainless steel. Flush cabinet doors with a 5/8" door stop are attached by a continuous hinge and equipped with zinc-plated handle and roller catch.
   2. Trim Style and Depth: Provide semi-recessed where recessed can’t be provided.
      a. Recessed: 3/8" flat trim.
      b. Semi-Recessed: 1-1/4", 1-1/2" Square Edge or 2-1/2", 3", 4" (recessed pull), 4-1/2" Rolled Edge.
   3. Finish: #4 Stainless Steel.
   4. Tub: Constructed of cold rolled steel with white powder-coat finish standard. Surface mount tubs are No 4 stainless.
   5. Fire-Rated: At fire-rated assembly.
   6. Door Styles: View Door Styles at Right.
   7. Door Glazing: Tempered Glass.

2.5 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   1. Color: Red.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter.
      a. Orientation: Vertical.

2.6 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.
      a. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.7 FINISHES, GENERAL

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

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STAINLESS-STEEL FINISHES

A. General: Remove tool and die marks and stretch lines or blend into finish.
   1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Bright, Directional Polish: No. 4 finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged units.

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

3.2 PREPARATION

A. Prepare recesses for recessed and semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated on Drawings.

B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
   1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104400

SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Front-projection screens.
   2. Projectors.
   3. Projector mount brackets.
   4. Flat screen mounts.

B. Related Sections include the following:
   1. Division 26 Sections for electrical service and connections including metal device boxes for switches and conduit, where required, for low-voltage control wiring.

1.3 DEFINITIONS

A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 SUBMITTALS

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

B. Shop Drawings: Show layouts and types of projection screens. Include the following:
   1. Location of screen centerline relative to ends of screen case.
   2. Location of wiring connections.
   3. Location of seams in viewing surfaces.
   4. Drop length.
   5. Connections to supporting structure for pendant- and recess-mounted screens.
   6. Anchorage details.
   7. Details of juncture of exposed surfaces with adjacent finishes.
   8. Frame details.
   9. Accessories.

10. Wiring Diagrams: For electrically operated units.

C. Samples for Initial Selection: For finishes of surface-mounted screen cases.

D. Maintenance Data: For projection screens to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

1.7 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of projection screens that fails in materials or workmanship within specified warranty period.
1. Warranty Period: 1 year.

B. Installer Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Projection Screens: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Draper. (Basis of Design)
2. Da-Lite.
3. Vutec.
4. Or equal.

B. Projector: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Epson.
   2. Hitachi.
   3. Sony.
   4. Panasonic.
   5. Dell.
   6. Or equal.

C. Projector mounting brackets: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
   1. Draper.
   2. Peerless Industries, Inc.
   3. Chief.
   4. Or equal.

D. Flat Screen Mounts:
   1. Peerless Industries, Inc.
   2. Sanus.
   3. Cotytech.
   4. Or equal.

2.2 FRONT-PROJECTION SCREENS

A. Product: Draper Model Targa by Draper or equal.
   1. Motorized projection screen.
   2. Size: As indicated on Drawings**.**
   3. Border: Black masking border.
   4. AT 1200 screen. Flame and mildew resistant.
   5. Mounting: Wall mount.
   6. Bottom of viewing surface attached to tubular steel slat with vinyl end protectors.

2.3 PROJECTOR

A. Product: Pro G7905U Series by Epson or equal.
   1. Large-venue projector delivers WUXGA performance with Epson® 4K Enhancement Technology.
   2. Projection System: High-aperture Epson 3-chip 3LCD technology.
   3. Native Resolution: WUXGA (1920 x 1200) w/ 4K Enhancement Technology.
   4. Color Brightness: 7000 lumens.
   5. White Brightness: 7000 lumens.

2.4 PROJECTOR MOUNTS

A. Product: Model PRS-UNV by Peerless Industries, Inc. or equal.
   1. Type: Pre-assembled, universal low profile ceiling mount.
   2. Image Alignment: Independent 25°(+5°/-20°) pitch, 20°(+10°) roll, 360° yaw (when attached to an extension column), and +/-15° yaw (when flush mounted).

3. Construction: Aluminum Alloy.
4. Mounting: Quick release spring loaded screw for easy removal and installation.
5. Attachment capabilities: 1-1/2 inch extension column, 3/4 inch extension column, or 3/8 inch threaded rod.
6. Adapter: Spider Universal Adapter Plate.
7. Finish: As selected by Architect.
8. Load capacity: 25 lb.
9. Product Weight: 2.5 lb.
10. Warranty: 5 years.
11. Optional Accessories:
    a. Ceiling plates.
    b. Cord wrap.
    c. Fixed and adjustable length extension columns, 1-1/2 inch NPT, “EXT’.
    d. Fixed length extension columns, 3/4 inch NPT (“FLP”).
    e. Armor Lock Plus security cable with lock (ACC 020).
    f. Armor Lock Plus security cable (ACC 021).
    g. Side to side adjuster (ACC 830).

2.5 FLAT SCREEN MOUNTS

A. Product: SmartMount Universal Tilt Wall Mount by Peerless-Industries, Inc. or equal.
1. SKU: ST660
2. Minimum to Maximum Screen Size 39 to 80 inches.
3. Distance from Wall: 2.63 - 5.71 inch.
4. Locking Increments: -5, 0, 5, 10, 15
5. Mounting Pattern: 32.75 x 15.95 inch.
6. Security Features: Security Hardware.
7. Tilt: +15 / -5.
8. Weight Capacity 200lbs.
9. Product Dimensions 36.54 x 16.89 x 2.62 - 5.40 inches.
10. Finish: Factory Powder Coat.
    a. Color: Black.
11. UPC Code 735029235606.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
1. Install low-voltage controls according to NFPA 70 and manufacturer's written instructions.

a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 115213

SECTION 22 05 10

PLUMBING GENERAL PROVISIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work.
B. Drawings and Specifications.
C. Industry Standards and Codes.
D. Site Examination.
E. Permits, Fees and Utility Connections.
F. Coordination of Work.
G. Progress of Work.
H. Submittals
I. Operation and Maintenance Manuals.
J. Project Record Documents.
K. Warranty.
L. Quality and Care
M. Access Doors.
N. Starting Equipment and Systems.

1.2 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.

1.3 REFERENCES

A. ANSI - American National Standards Institute.
B. ASTM - American Society for Testing Materials.
C. CEC - California Electric Code.
D. NEC - National Electric Code.
E. NEMA - National Electric Manufacturers' Association.
F. NFPA - National Fire Protection Association.
G. OSHA - Occupational Safety and Health Act.
H. UL - Underwriters' Laboratories.
I. See detailed References that are listed in individual sections.

1.4 DESCRIPTION OF WORK

A. The work included in this division of the specifications consists of furnishing labor, tools, equipment, supplies and materials, unless otherwise specified, and in performing

operations necessary for the installation of the complete Plumbing System as required by these specifications or shown on the Drawings, subject to the terms and conditions of the Contract Agreement.

B. The work shall also include the completion of details of plumbing work not mentioned or shown which are necessary for the successful operation of mechanical systems described on the drawings or required by these specifications. Furnish and install any incidental work not shown or specified which is required to provide a complete and operational system.

1.5 DRAWINGS AND SPECIFICATIONS

A. Drawings are schematic and diagrammatic. Drawings indicate the general arrangement of equipment, piping, and other plumbing work. Use judgement and care to install mechanical work to fit the job conditions within the building construction and finishes, and to function properly.

B. The Contractor shall investigate the building conditions affecting the Work and shall arrange his work accordingly providing offsets, fittings, valves and accessories to fit the actual job conditions. The Contractor shall be responsible to field measure and confirm new and existing mechanical systems locations with respect to other architectural, structural, and electrical work, existing and new. Do not scale distances off of the mechanical drawings. Use actual building dimensions.

C. The drawings and specifications are complimentary each to the other. What is required by one shall be as binding as if called for by both.

D. Examine all drawings and specifications prior to bidding the Work. Report any discrepancies to the Engineer.

1.6 INDUSTRY STANDARDS AND CODES

A. The Mechanical Contractor shall comply with the latest provisions of all codes, regulations, laws and ordinances applicable to the work involved. This does not relieve the Contractor from furnishing and installing work shown or specified which may exceed the requirements of such codes, regulations laws and ordinances.

B. All materials, products, devices, fixtures forms or types of construction included in this project shall meet or exceed the published requirements of the publications listed below. These publications form a part of this specification.
   1. California Building Code, 2019.
   2. California Mechanical Code, 2019.
   3. California Plumbing Code, 2019.
   4. California Electrical Code, 2019.
   5. National Fire Protection Association.
   6. California Fire Code, 2019.
   7. California State Fire Marshal.
   8. Occupational Safety and Health Administration, including CAL-OSHA.
   9. California Energy Code, 2019.
   10. California Green Building Standards Code, 2019.
   11. State of California Code of Regulations, Title 24.
   12. Other applicable state laws.

C. Nothing in the Drawings or Specifications shall be construed to permit work that does not conform these codes. When Contract Documents differ from governing codes,

furnish and install to the higher standard required at no extra charge. The Contract Documents are not intended to repeat the code requirements except where necessary for clarity.

D. No material or product installed as a part of the Work shall contain asbestos in any form.
E. Domestic water piping and components shall be provided and installed in accordance with California AB 1953 Legislation (effective January 1, 2010), which limits the allowable lead content in certain domestic water system components.

1.7 SITE EXAMINATION

A. Contractor shall examine the site, verify dimensions and locations with Drawings, check utility connection locations, and familiarize himself with the existing conditions and limitations. No extras will be allowed because of the Contractor's misunderstanding of the amount of work involved or his lack of knowledge of any site condition which may affect his work. Any apparent variance of the drawings or specifications from the existing conditions at the site shall be called to the attention of the Engineer immediately.

1.8 PERMITS, FEES AND UTILITY SERVICES

A. Contractor shall pay for and obtain all permits and service required in the installation of this work.
B. Contractor shall arrange for all required inspections and will secure approvals from authorities having jurisdiction.

1.9 COORDINATION OF WORK

A. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work and that such establishment is the exclusive responsibility of the contractor.
B. The Contractor shall give careful consideration to the work of the General, Electrical and other contractors on the job and shall organize his work so that it will not interfere with the work of other trades. He shall consult the drawings and specifications for work of other trades for correcting information, and the pertinent drawings for details and dimensions.
C. Arrange plumbing work in a neat, well-organized manner with the piping and similar services running parallel and/or perpendicular to primary lines of the building construction. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.
D. Verify the location of all equipment, plumbing devices, etc. and if interference develops, the Owner/Engineer's decision will be final and no additional compensation will be allowed for the moving of misplaced air devices or equipment.

1.10 PROGRESS OF WORK

A. This Contractor shall organize his work so that the progress of the mechanical work will conform to the progress of the other trades, and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting

from defective or ill timed work performed under this section shall be borne by this Contractor.

1.11 STRUCTURAL DESIGN REQUIREMENTS AND SEISMIC RESTRAINTS

A. Plumbing systems and equipment shall be anchored and seismically braced in accordance with all applicable codes and industry standards.
B. Plumbing systems and equipment shall include, but are not limited to, all piping, water heaters, expansion tanks, air compressors, vacuum pumps, electrical and control panels, conduits and other components.
C. For all non-standard installations not detailed in one of the approved systems, the Contractor shall provide details of supports, anchorages and restraints, including attachments to building structure, with supporting calculations all stamped and signed by a licensed professional structural engineer registered in the state in which the Work is performed.

1.12 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project.
C. Organize submittals in sequence according to Specification Section. Submit in bound document with tabs identifying each Specification Section. Provide a Table of Contents identifying the Specifications Sections being submitted and the contents within each tabbed section. Prepare Submittals in multiple volumes if required. Provide a complete Submittal package at one time. Do not submit individual Sections piecemeal.
D. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
E. Furnish, upon request, installation instructions for all equipment and materials to Inspector of Record prior to installation.
F. Maintain a copy of the fire penetration installation instructions on site for use by the Inspector of Record.

1.13 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
B. LP Consulting Engineers, Inc. will consider requests for substitutions only within 7 days after date of Agreement.
C. Substitutions may be considered when a product becomes unavailable through no fault of the .
D. Failure by the Contractor to order materials or equipment in a timely manner will not constitute justification for a substitution.
E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
F. A request for substitution constitutes a representation that the submitter:
    1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse LP Consulting Engineers, Inc. for review or redesign services associated with reapproval by authorities including obtaining reapproval by authorities.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. If excessive review, as judged by the Engineer, is required caused by complicated, numerous or repetitive requests, Contractor shall reimburse Engineer and its Consultants for such review at their standard billing rates.

I. Substitution Submittal Procedure:
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. The LP Consulting Engineers, Inc. will notify in writing of decision to accept or reject request.
4. Present each substitution individually. If a proposed substitute in not found to be acceptable, then the specified item shall be supplied.

1.14 PROJECT RECORD DOCUMENTS

A. Provide red-lined drawings accurately showing location of equipment and devices and size and routing of piping. Include notes explaining installed condition for complete understanding.

1.15 QUALITY ASSURANCE

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from LP Consulting Engineers, Inc. before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

1.16 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.17 WARRANTY

A. See Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 QUALITY AND CARE

A. All materials shall be new and in perfect condition when installed unless specifically indicated otherwise. Materials shall be tested within the Continental United States by an independent, nationally recognized testing agency and shall be listed in accordance with testing agency requirements. When not otherwise specified, all material shall conform to applicable National Standards (ANSI).
B. All capacities, sizes and efficiency ratings shown on the drawing are minimum. Gas meter and gas pressure reducing valve capacities are maximum allowable.
C. Each category of material or equipment shall be of the same brand or manufacturer throughout the Work wherever possible.
D. The quality of materials and equipment to be provided is defined by the brand names, manufacturers, model and catalog numbers listed on the Drawings and in the Specifications. Contractor shall provide each item listed, of the quality specified, or equal.
E. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
F. Inspect and report concealed damage to carrier within their required time period.
G. Store materials in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect from dirt, water, construction debris, and traffic.
H. Equipment which has been damaged, exposed to weather or is, in the opinion of the Engineer or Owner, otherwise unsuitable because of improper fabrication, storage or installation shall be removed and replaced by this Contractor at his expense.

2.2 ACCESS DOORS

A. Coordinate access door requirements. The more stringent requirements shall govern.
B. Provide access doors where access through floors, walls or ceilings is required to access plumbing equipment and plumbing devices or other systems requiring access for maintenance, test or observation.
    1. Access doors requiring hand access or access for observation only shall be 14"x14" minimum usable opening.
    2. Access doors where entrance of a service person may be required shall be 24"x30" minimum usable opening.
C. Established standard: Milcor of types listed below. Other acceptable manufacturers: Cesco, J.L. Industries, Karp, Larsen's, or equal. Comply with the following:
    1. Form doors and frames of welded, ground smooth steel construction, 14 gauge for doors, 16 gauge for frames. Provide prime coat finish except for stainless steel type.
    2. Concealed hinges to allow 175 degree opening.

3. Locks: flush, screw driver operated cam lock(s).
4. Provide anchoring devices suitable for the construction into which the doors are framed.

D. Application (as applicable):
1. In gypsum drywall walls and ceilings: Type DW.
2. In ceramic tile walls: Type MS (stainless steel).
3. In fire rated walls: Type Fire Rated (rating as required for wall or ceiling), self closing, 250 F in 30 min. temperature rating.

PART 3 EXECUTION

3.1 INSTALLATION

A. Access Doors
1. Coordinate the exact location of access doors to provide proper access to the item concealed. Obtain written approval for access door locations from Architect.
2. Coordinate installation of access doors with the trades performing the construction assemblies into which the access doors are placed.
3. Install all access doors neatly and securely, to open and close completely, and to operate freely and without binding. Install rated doors in accordance with their listing requirements.
4. Test operate all doors and make all adjustments required for satisfactory operation. Replace all damaged materials.
5. Install in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with the requirements within this section.
B. Test all piping with no leak or loss in pressure in accordance with the requirements within this section.

3.3 GENERAL TESTING REQUIREMENTS FOR MECHANICAL AND PLUMBING SYSTEMS

A. Contractor shall assign a responsible person to be an independent representative to witness testing and to sign as witness of times, pressure and losses of testing media for all hydronic, duct and gas piping testing.
1. Test all piping as noted below with no leak or loss of pressure. Repair or replace defective piping until tests are accomplished successfully.
2. Submit to the Engineer for review a log of all tests made which shall include time, temperature, pressure, water makeup and other applicable readings, necessary to indicate the systems have been operated and tested in the manner outlined in the construction documents.
3. After producing the specified test pressure, disconnect the pressurizing source; do not introduce further pressure for the duration of the test period, repair leaky piping and retest. Repeat the procedure until the entire system is proven tight.

B. Test the following systems with the medium listed to the pressure indicated for the time period listed:

1. Sanitary Sewer, Drain, Vent Piping: Pressure=10 Ft.Hd. / Medium= Water / Duration=4 Hours.
2. Domestic Water Piping: Pressure=125 Psig / Medium= Water / Duration=4 Hours.
3. Condensate drains: Pressure=10 Ft.Hd. / Medium=Water / Duration=4 Hours.
4. Gas Piping: Pressure=60 Psig / Medium=Air and soap / Duration=8 Hours.

3.4 CUTTING AND PATCHING

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of separate Contractor.

B. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

C. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

E. Restore work with new Products in accordance with requirements of Contract Documents.

F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Code requirements , to full thickness of the penetrated element.

H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.5 PRIMING AND PAINTING

A. Apply primer to all exposed ferrous metals that are not factory primed, factory finished, galvanized, stainless steel or anodized. Exposed black steel piping shall be primed and finish painted, including gas piping outdoors.
   1. Primer shall be as recommended by the paint manufacturer for each specific application.
   2. Acceptable Products include: Fuller O'Brien Blox-Rust Metal All Purpose Primer, equivalent Rust-Oleum product, or equal. See Section 09900 for other acceptable products.

B. Apply two coats of primer to metal surfaces of items to be insulated or jacketed, except piping, or factory primed or finished.

C. Preparation:

1. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
2. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; seal stains and marks which cannot be completely removed using Devoe KILSTAIN primers, shellac, or other coating acceptable to paint manufacturer any marks or defects that might bleed through paint finishes.
3. Remove mildew from impervious surfaces by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow substrate to thoroughly dry.
4. Galvanized Surfaces:
   a. Remove surface contamination and oils by solvent cleaning in accordance with SSPC-SP 1 and allow to dry.
   b. Apply Devoe MIRROLAC Galvanized Metal Primer in accordance with manufacturer instructions.
5. Uncoated Steel And Iron Surfaces:
   a. Remove grease, rust, scale, and dust from steel and iron surfaces using solvent in accordance with SSPC-SP 1.
   b. Where heavy coatings of scale or contaminants are evident, hand tool clean in accordance with SSPC-SP 2 or use other approved SSPC SP method as needed.
6. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate Devoe MIRROLAC metal primer or primer recommended by manufacturer.

D. Application:
1. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
2. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
3. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

3.6 STARTING EQUIPMENT AND SYSTEMS/COMMISSIONING

A. Start equipment and systems in accordance with manufacturer's written instructions..
B. Adjust for proper operation within manufacturer's published tolerances.
C. Description:
1. Comply with all start up of mechanical and electrical equipment systems as required in the various sections and herein.
2. Coordinate all testing and startup procedures with all other trades so that all non-plumbing and non-electrical work is completed and operational so that the specified testing can be performed.

D. Preliminary Work:
1. Prior to the startup, the Contractor shall ensure that the systems are ready to operate, and the following items have been completed and checked including but not limited to:

a. Proper motor and fan/pump rotation.
b. Flushing and cleaning of the system.
c. Wiring
d. Auxiliary connections
e. Lubrication.
f. Venting.
g. Controls.
h. Installation of filters and strainers.
i. Setting of relief and safety valves .

2. All electrical testing must be completed and test results submitted before equipment startup to avoid power interruptions during mechanical equipment startup and testing.
3. The Contractor shall submit at least 30 days in advance a schedule listing the date of completion of his work as it will be ready for equipment startup of Electrical/Plumbing equipment. This schedule shall include work on a system by system, floor by floor basis.
4. Two weeks prior to the startup of any major equipment, the Contractor shall certify in writing that the systems will be complete and ready for startup. Completeness shall not only include physical installation of individual pieces of equipment, but all related elements of other crafts to make all equipment operate as a system.
   a. The startup checklist will cover all related crafts, e.g., controls, electrical, plumbing, and a clean environment for equipment startup.
5. The Contractor shall schedule a tour with the Owner's representative and the Engineer to review startup conditions prior to equipment startup. This tour shall take place during the associated Engineer's regularly scheduled visit. This tour does not relieve the Contractor of any responsibilities to properly start equipment. The Engineer will issue a notice of deficiencies that will be required to be corrected prior to equipment startup. The Contractor will be required to reschedule a back check with the Engineer prior to attempting an equipment startup.
6. Equipment of systems should not be started until systems and associated subsystems are completed. Verify that other continuing work could not possibly damage completed systems if they are in operation. Furnish signed off prestartup check sheet.

E. Startup and Commissioning:
   1. System Startup and Operation:
      a. The Contractor shall provide all labor, materials and services necessary for the initial startup and operation of all systems and equipment furnished and installed under this section.
      b. The Contractor and the factory representative shall check all equipment during initial startup to insure correct rotation, proper lubrication, adequate fluids or air flows, nonoverloading electrical characteristics, proper alignment and vibration isolation. Systems shall be checked for water flows throughout without blockages.Plumbing systems shall be checked for proper connections and positions, nonexcessive electrical characteristics and minimal vibration. Other miscellaneous equipment shall be started and operated as described

above as applicable. Manufacturer's representative shall submit a preliminary written copy of equipment startup check sheet prior to leaving job site.

c. After initial startup and operation of systems, the Contractor shall submit a report, showing proper operation before commencement of the final "Operation Test".

d. During initial operation of the system and until substantial completion, qualified personnel shall be provided and designated for maintaining the equipment and systems in good running order. Items such as strainers, cleanouts, packing replacement, and other consumables shall be provided without cost to the Owner. Failure of equipment during this period due to lack of proper supervision is the responsibility of the Contractor and continued failures shall be grounds for the Owner to provide such services with back charges to the Contractor. Submit written schedule of completed maintenance to the Engineer.

F. System Acceptance:

1. General: The system installation shall be complete and tested for proper operation prior to acceptance testing "Operation Test" for the Owners authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify that all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing shall commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative and pass, the system will be accepted. The warranty period may begin at this time.

G. Operation Test:

1. Provide all labor, equipment, and materials required to perform test.
2. The test shall occur after all major equipment startup and balance services have been performed as specified. The purpose is to demonstrate that individual pieces of equipment and all related elements operate as one complete system and not to identify incomplete or defective work.
3. All equipment is to be run in an automatic operating position and exercised for 72 hours to verify that they perform in accordance with the specified sequence of operation and designed operation logic.
4. The Engineer's representative shall be notified and may be present for the initiation of the test.
5. A log shall be prepared by the Contractor, to be submitted to the Engineer, of all tests including, but not limited to: time, temperatures, pressures, and other readings to prove all equipment is operating as specified.
6. All temperatures, pressures, status indication, etc., shall be verified by at least one other means of measurement or visual verification of condition.
7. Change set points and simulate conditions as directed to demonstrate:
   a. Ability to control to new set point.
   b. Interface between systems, fire alarm/fire sprinkler systems.
   c. Proper sequence and operation.
   d. Equipment safety systems and all automatic changeover/backup systems and alarms are functioning or will function.

8. If unsatisfactory performance or a system failure is experienced for any reason, the test shall be repeated until 72 hour consecutive hours are achieved. The Engineer's representative shall make all final decisions of a satisfactory test.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Strut systems for pipe or equipment support.
B. Beam clamps.
C. Pipe hangers.
D. Pipe rollers and roller supports.
E. Pipe supports, guides, shields, and saddles.
F. Seismic bracing hardware.
G. Nonpenetrating rooftop supports for low-slope roofs.
H. Anchors and fasteners.

1.2 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2022.
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).
F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
N. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
C. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
E. Fire Resistance: Provide hardware rated for 120 minutes resistance unless specifically indicated by the authority having jurisdiction.
F. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.
    1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
    2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.2 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:
    1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
    2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
B. Hanger Rods:
    1. Threaded zinc-plated steel unless otherwise indicated.
    2. Minimum Size, Unless Otherwise Indicated or Required:
        a. Equipment Supports: 1/2 inch diameter.
        b. Piping up to 4 inch: 3/8 inch diameter.

c. Piping larger than 4 inch: 1/2 inch diameter.
d. Trapeze Support for Multiple Pipes: 3/8 inch in length.

C. Channel Nuts:
1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.3 BEAM CLAMPS

A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
B. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
C. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.4 PIPE HANGERS

A. J-Hangers, Adjustable:
1. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
2. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
B. Swivel Ring Hangers, Adjustable:
1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
C. Clevis Hangers, Adjustable:
1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
2. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
3. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
4. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.5 PIPE CLAMPS

A. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
B. Extension Split Pipe Clamp:
1. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
2. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
3. Provide hanger rod and nuts of the same type and material for a given pipe run.
4. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
D. Strut Clamps:
   1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
   2. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
E. Insulation Coupling:
   1. Two bolt-type clamps designed for installation under insulation.
   2. Material: Carbon steel with epoxy copper or zinc finish.

2.6 PIPE ROLLERS AND ROLLER SUPPORTS

A. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
B. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.7 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
B. Stanchions:
   1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
   2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
   3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
C. U-Bolts:
   1. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
D. Pipe Alignment Guides, Galvanized steel:
   1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
   2. Pipe Sizes 10 inch and Larger: Roller type.
E. Pipe Shields for Insulated Piping:
   1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
   2. General Construction and Requirements:
      a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
      b. Shields Material: UV-resistant polypropylene with glass fill.
      c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
      d. Service Temperature: Minus 40 to 178 degrees F.
      e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
F. Pipe Supports:
   1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
   2. Liquid Temperatures Up to 122 degrees F:
      a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.

b. Support From Below: MSS SP-58 types 35 through 38.

3. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
   b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 types 35 through 38.

G. Pipe Supports, Thermal Insulated:
   1. General Requirements:
      a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
      b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
      c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
      d. Provide pipe supports for 1/2 to 30 inch iron pipes.
      e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
   2. PVC Jacket:
      a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
      b. Minimum Service Temperature: Minus 40 degrees F.
      c. Maximum Service Temperature: 180 degrees F.
      d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
      e. Minimum Thickness: 60 mil, 0.06 inch.

2.8 SEISMIC BRACING HARDWARE

A. Cable Sway Bracing Systems:
   1. Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
   2. Provide cable wire and end-fixing as required to hold minimum weight of 100 lb.

2.9 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

A. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
B. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
C. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
D. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.10 ANCHORS AND FASTENERS

A. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
B. Concrete: Use preset concrete inserts or expansion anchors.
C. Solid or Grout-Filled Masonry: Use expansion anchors.
D. Hollow Masonry: Use toggle bolts.
E. Hollow Stud Walls: Use toggle bolts.
F. Steel: Use beam clamps, machine bolts, or welded threaded studs.
G. Sheet Metal: Use sheet metal screws.
H. Wood: Use wood screws.
I. Plastic and lead anchors are not permitted.
J. Powder-actuated fasteners are not permitted.
K. Hammer-driven anchors and fasteners are not permitted.
L. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
M. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    1. Channel Material: Use galvanized steel.
    2. Manufacturer: Same as manufacturer of metal strut channel framing system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
D. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.
E. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.
F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
H. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
J. Secure fasteners according to manufacturer's recommended torque settings.
K. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.
B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Pipe markers.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.
B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Product Data: Provide manufacturers catalog literature for each product required.
D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Heat Transfer Equipment: Nameplates.
B. Major Control Components: Nameplates.
C. Piping: Pipe markers.
D. Pumps: Nameplates.
E. Small-sized Equipment: Tags.
F. Tanks: Nameplates.
G. Valves: Tags and ceiling tacks where located above lay-in ceiling.
H. Water Treatment Devices: Nameplates.

2.2 MANUFACTURERS

A. Brady Corp.
B. Seton Identification Products.

2.3 NAMEPLATES

A. Description: Laminated piece with up to three lines of text.
    1. Letter Color: White.

2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Plastic: Comply with ASTM D709.

2.4 TAGS

A. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch in diameter.
B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.

2.5 PIPE MARKERS

A. Comply with ASME A13.1.
B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Secure to pipe using two (2) bands of adhesive tape with flow arrows supplied by the manufacturer. Install securing bands completly around pipe and overlapped.
C. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive identification products.

3.2 INSTALLATION

A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
B. Install tags in clear view and align with axis of piping
C. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
D. Identify domestic hot water heating equipment, including pumps, etc. with plastic nameplates.
E. Identify valves in main and branch piping with tags.
F. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
G. Identify all medium pressure gas piping (over 11" W.C. to 5 PSI pressure) with pressure contained within piping system (for example: "MPG 5 PSI")

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.
B. Piping insulation.
C. Glass fiber insulation.
D. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).
C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2017.
E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.
F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.
G. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing 2022.
H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).
I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.
B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER INSULATION

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufusa.com.
   4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/#sle.
B. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible.
   1. 'K' value: ASTM C 177, 0.22 to 0.28 at 100 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.
C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
D. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
   2. K-Flex USA LLC; Insul-Tube: www.kflexusa.com/#sle.
   3. Owens Corning Flex Tubing

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3; use molded tubular material wherever possible and sheet for equipment and other surfaces.
   1. 'K' value: ASTM C 177; 0.27 at 75 degrees F.
   2. Minimum Service Temperature: Minus 40 degrees F.
   3. Maximum Service Temperature: 220 degrees F.
   4. Maximum Moisture Absorption - Pipe Insulation: 3.5 percent, by weight, when tested in accordance with ASTM D 1056.
   5. Water Vapor Permeability: 0.20 perm-inches, when tested in accordance with ASTM E 96.
   6. Connection: Waterproof vapor barrier adhesive.
C. Elastomeric Foam Adhesive:
D. Insulation Exposed to the Weather: Finish with two coats Armstrong white Armaflex finish. Provide aluminum jacketing.

2.4 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:
   1. Manufacturers:
      a. Proto Corporation, Proto-Wrap 30 LoSmoke.
      b. Johns Manville Corporation: www.jm.com.
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil, 0.010 inch.
      e. Connections: Brush on welding adhesive.
   3. Covering Adhesive Mastic: Compatible with insulation.
B. Aluminum Jacket:
   1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
   2. Thickness: 0.016 inch sheet.
   3. Finish: Embossed.
   4. Joining: Longitudinal slip joints and 2 inch laps.
   5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
   6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.
B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.
C. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with molded PVC fitting covers.
D. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with vapor barrier, factory-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with molded PVC fitting covers.
E. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert Location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, use a UL rated fire penetration assembly, 3M or equal.
G. Pipe in Supply Air Plenum or Finished Spaces: Finish with PVC jacket and fitting covers.
H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
I. Exterior Applications (exposed to the weather): Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES

A. Plumbing Systems:
   1. Domestic Hot and Tempered Water Supply:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1-1/2 inch and larger.
            (a) Thickness: 2 inch.
         2) Pipe Size Range: 1 inch and smaller.
            (a) Thickness: 1-1/2 inch.
   2. Domestic Cold Water Located in Unheated Areas:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1-1/2 inch and larger.
            (a) Thickness: 1 inch.
         2) Pipe Size Range: 1 inch and smaller.

(a) Thickness: 3/4 inch.

END OF SECTION

SECTION 22 10 05

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drains.
B. Pipe flanges, unions, and couplings.
C. Pipe hangers and supports.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
D. Section 22 07 19 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems 2015 (Reaffirmed 2020).
B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.
C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV 2021.
D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV 2017.
E. ASME B31.9 - Building Services Piping 2020.
F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
G. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.
H. ASTM B32 - Standard Specification for Solder Metal 2020.
I. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.
J. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.
K. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.
L. AWWA C651 - Disinfecting Water Mains 2014, with Addendum (2020).
M. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2021.
N. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2020.
O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
P. MSS SP-67 - Butterfly Valves 2022.
Q. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

R. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
S. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
T. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
C. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of California, standards.
B. Valves: Manufacturer's name and pressure rating marked on valve body.
C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of California plumbing code.
B. Domestic water piping and components shall be provided and installed in accordance with California AB 1953 Legislation (effective January 1, 2010), which limits the allowable lead content in certain domestic water system components.
C. Conform to applicable code for installation of backflow prevention devices.
D. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 DRAIN PIPING, ABOVE GRADE

A. Copper Tube: ASTM B 306, DWV or ASTM B 88 (ASTM B 88M), Type M (C), Drawn (H).
    1. Application: Condensate drains inside building (non-acidic).
    2. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.
    3. Joints: ASTM B32, alloy Sn50 solder.

B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
   1. Application: Condensate drains outside building (non-acidic).
   2. Threaded Joints: ASME B16.3 malleable iron fittings.
C. PVC Pipe: ASTM D2665.
   1. Application: Condensate drains (acidic).
   2. Fittings: PVC.
   3. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.3 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 2 Inches and Under:
   1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
B. Flanges for Pipe Sizes Over 2 inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.4 PIPE HANGERS AND SUPPORTS

A. See Section 22 05 29 for additional requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt, on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
E. Group piping whenever practical at common elevations.
F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
H. Provide access where valves and fittings are not exposed.

I. Provide anodeless transition riser at gas piping transition from below grade to above grade.
J. All natural gas piping exposed to outdoors shall be primed and painted, color by architect.
K. All ABS and PVC pipe material exposed to outdoors shall be primed and painted, color by architect.
L. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
M. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.
N. Install water piping to ASME B31.9.
O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
P. Sleeve pipes passing through partitions, walls, and floors.
Q. Pipe Hangers and Supports:
    1. Install in accordance with ASME B31.9.
    2. Support horizontal piping as indicated.
    3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
    4. Place hangers within 12 inches of each horizontal elbow.
    5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
    6. Provide copper plated hangers and supports for copper piping.
    7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
    8. Support cast iron drainage piping at every joint.

3.4 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.
B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.5 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.
B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
E. Maintain disinfectant in system for 24 hours.
F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SCHEDULES

A. Pipe Hanger Spacing:
    1. Metal Piping:
        a. Pipe Size: 1/2 inch to 1-1/4 inch:
            1) Maximum Hanger Spacing: 6.5 ft.
            2) Hanger Rod Diameter: 3/8 inches.
        b. Pipe Size: 1-1/2 inch to 2 inch:
            1) Maximum Hanger Spacing: 10 ft.
            2) Hanger Rod Diameter: 3/8 inch.
        c. Pipe Size: 2-1/2 inch to 3 inch:
            1) Maximum Hanger Spacing: 10 ft.
            2) Hanger Rod Diameter: 1/2 inch.
        d. Pipe Size: 4 inch to 6 inch:
            1) Maximum Hanger Spacing: 10 ft.
            2) Hanger Rod Diameter: 5/8 inch.

END OF SECTION

SECTION 23 01 30.51

HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of HVAC duct system, equipment, and related components.

1.2 DEFINITIONS

A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.
   1. Above-ceiling plenum for supply air is required to be cleaned.
   2. Above-ceiling plenum for return air is required to be cleaned.
   3. Makeup air system is required to be cleaned.
   4. Exhaust-only system is required to be cleaned.

1.3 REFERENCE STANDARDS

A. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System 2021.
B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
C. UL 181A - Closure Systems for Use with Rigid Air Ducts Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 TOOLS AND EQUIPMENT

A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

A. Comply with applicable federal, state, and local requirements.

B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
D. Obtain ABC's approval of proposed temporary locations for large equipment.
E. Designate a decontamination area and obtain ABC's approval.
F. If unforeseen mold or other biological contamination is encountered, notify LP Consulting Engineers, Inc. immediately, identifying areas affected and extent and type of contamination.

3.2 PREPARATION

A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
    1. Do not cut openings in non-HVAC components without obtaining the prior approval of ABC.
    2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
    3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.3 CLEANING

A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
B. Obtain ABC's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
C. Ducts: Mechanically clean all portions of ducts.
D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.

G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.4 REPAIR

A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
C. Reseal new openings in accordance with NADCA Standard 05.
D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to ABC in project report documents.

3.5 FIELD QUALITY CONTROL

A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
D. Notify LP Consulting Engineers, Inc. when cleaned components are ready for inspection.
E. When directed, re-clean components until they pass.
F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.6 ADJUSTING

A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.7 WASTE MANAGEMENT

A. Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.
B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION

SECTION 23 05 10

MECHANICAL GENERAL PROVISIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work.
B. Drawings and Specifications.
C. Industry Standards and Codes.
D. Site Examination.
E. Permits, Fees and Utility Connections.
F. Coordination of Work.
G. Progress of Work.
H. Submittals
I. Operation and Maintenance Manuals.
J. Project Record Documents.
K. Warranty.
L. Quality and Care
M. Access Doors.
N. Starting Equipment and Systems.

1.2 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.
D. Section 017000 - Closeout Procedures.

1.3 REFERENCES

A. ANSI - American National Standards Institute.
B. ASTM - American Society for Testing Materials.
C. CEC - California Electric Code.
D. NEC - National Electric Code.
E. NEMA - National Electric Manufacturers' Association.
F. NFPA - National Fire Protection Association.
G. OSHA - Occupational Safety and Health Act.
H. UL - Underwriters' Laboratories.
I. See detailed References that are listed in individual sections.

1.4 DESCRIPTION OF WORK

A. The work included in this division of the specifications consists of furnishing labor, tools, equipment, supplies and materials, unless otherwise specified, and in performing operations necessary for the installation of the complete Mechanical System as required by these specifications or shown on the Drawings, subject to the terms and conditions of the Contract Agreement.
B. The work shall also include the completion of details of mechanical work not mentioned or shown which are necessary for the successful operation of mechanical systems described on the drawings or required by these specifications. Furnish and install any incidental work not shown or specified which is required to provide a complete and operational system.

1.5 **DRAWINGS AND SPECIFICATIONS**

A. Drawings are schematic and diagrammatic. Drawings indicate the general arrangement of equipment, piping, ductwork and other mechanical work. Use judgement and care to install mechanical work to fit the job conditions within the building construction and finishes, and to function properly.
B. The Contractor shall investigate the building conditions affecting the Work and shall arrange his work accordingly providing offsets, fittings, valves and accessories to fit the actual job conditions. The Contractor shall be responsible to field measure and confirm new and existing mechanical systems locations with respect to other architectural, structural, and electrical work, existing and new. Do not scale distances off of the mechanical drawings. Use actual building dimensions.
C. The drawings and specifications are complimentary each to the other. What is required by one shall be as binding as if called for by both.
D. Examine all drawings and specifications prior to bidding the Work. Report any discrepancies to the Engineer.

1.6 INDUSTRY STANDARDS AND CODES

A. The Mechanical Contractor shall comply with the latest provisions of all codes, regulations, laws and ordinances applicable to the work involved. This does not relieve the Contractor from furnishing and installing work shown or specified which may exceed the requirements of such codes, regulations laws and ordinances.
B. All materials, products, devices, fixtures forms or types of construction included in this project shall meet or exceed the published requirements of the publications listed below. These publications form a part of this specification.
    1. California Building Code, 2019.
    2. California Mechanical Code, 2019.
    3. California Plumbing Code, 2019.
    4. California Electrical Code, 2019.
    5. National Fire Protection Association.
    6. California Fire Code, 2019.
    7. California State Fire Marshal.
    8. Occupational Safety and Health Administration, including CAL-OSHA.
    9. California Energy Code, 2019.
    10. California Green Building Standards Code, 2019.

11. State of California Code of Regulations, Title 24.
12. Other applicable state laws.

C. Nothing in the Drawings or Specifications shall be construed to permit work that does not conform these codes. When Contract Documents differ from governing codes, furnish and install to the higher standard required at no extra charge. The Contract Documents are not intended to repeat the code requirements except where necessary for clarity.

D. No material or product installed as a part of the Work shall contain asbestos in any form.

1.7 SITE EXAMINATION

A. Contractor shall examine the site, verify dimensions and locations with Drawings, check utility connection locations, and familiarize himself with the existing conditions and limitations. No extras will be allowed because of the Contractor's misunderstanding of the amount of work involved or his lack of knowledge of any site condition which may affect his work. Any apparent variance of the drawings or specifications from the existing conditions at the site shall be called to the attention of the Engineer immediately.

1.8 PERMITS, FEES AND UTILITY SERVICES

A. Contractor shall pay for and obtain all permits and service required in the installation of this work.

B. Contractor shall arrange for all required inspections and will secure approvals from authorities having jurisdiction.

1.9 COORDINATION OF WORK

A. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work and that such establishment is the exclusive responsibility of the contractor.

B. The Contractor shall give careful consideration to the work of the General, Electrical and other contractors on the job and shall organize his work so that it will not interfere with the work of other trades. He shall consult the drawings and specifications for work of other trades for correcting information, and the pertinent drawings for details and dimensions.

C. Arrange mechanical work in a neat, well-organized manner with the piping, conduit, and similar services running parallel and/or perpendicular to primary lines of the building construction. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.

D. Verify the location of all equipment, and devices, etc. and if interference develops, the Owner/Engineer's decision will be final and no additional compensation will be allowed for the moving of misplaced air devices or equipment.

1.10 PROGRESS OF WORK

A. This Contractor shall organize his work so that the progress of the mechanical work will conform to the progress of the other trades, and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting

from defective or ill timed work performed under this section shall be borne by this Contractor.

1.11 STRUCTURAL DESIGN REQUIREMENTS AND SEISMIC RESTRAINTS

A. Mechanical systems and equipment shall be anchored and seismically braced in accordance with all applicable codes and industry standards.
B. Mechanical systems and equipment shall include, but are not limited to, all piping, heating and ventilating equipment, electrical and control panels, conduits and other components.
C. For all non-standard installations not detailed in one of the approved systems, the Contractor shall provide details of supports, anchorages and restraints, including attachments to building structure, with supporting calculations all stamped and signed by a licensed professional structural engineer registered in the state in which the Work is performed.

1.12 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project.
C. Organize submittals in sequence according to Specification Section. Submit in bound document with tabs identifying each Specification Section. Provide a Table of Contents identifying the Specifications Sections being submitted and the contents within each tabbed section. Prepare Submittals in multiple volumes if required. Provide a complete Submittal package at one time. Do not submit individual Sections piecemeal.
D. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
E. Furnish, upon request, installation instructions for all equipment and materials to Inspector of Record prior to installation.
F. Maintain a copy of the fire and smoke damper installation instructions on site for use by the Inspector of Record.

1.13 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
B. LP Consulting Engineers, Inc. will consider requests for substitutions only within 7 days after date of Agreement.
C. Substitutions may be considered when a product becomes unavailable through no fault of the .
D. Failure by the Contractor to order materials or equipment in a timely manner will not constitute justification for a substitution.
E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
F. A request for substitution constitutes a representation that the submitter:
    1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse LP Consulting Engineers, Inc. for review or redesign services associated with reapproval by authorities including obtaining reapproval by authorities.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. If excessive review, as judged by the Engineer, is required caused by complicated, numerous or repetitive requests, Contractor shall reimburse Engineer and its Consultants for such review at their standard billing rates.

I. Substitution Submittal Procedure:
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. The LP Consulting Engineers, Inc. will notify in writing of decision to accept or reject request.
4. Present each substitution individually. If a proposed substitute in not found to be acceptable, then the specified item shall be supplied.

1.14 OPERATION AND MAINTENANCE MANUALS

A. See Section 01700 Closeout Submittals for Operation and Maintenance Manual requirements.

B. Provide operating and maintenance instructions, diagrams and parts lists for all components of all mechanical systems and each piece of equipment furnished under these specifications.

C. Operating and maintenance instructions shall be furnished for the following equipment and systems:
1. Ventilating Systems.
2. Air Conditioning Systems.
3. Temperature Controls Systems.
4. Testing, Adjusting, and Balancing Reports.

D. Provide manufacturer's model number, design data, capacities, etc. for each piece of mechanical equipment furnished as a part of the Work.

E. The operating instructions shall include procedures for starting, stopping and emergency manual operation for all equipment and systems.

F. Provide maintenance instructions of each item of individual equipment including applicable maintenance data as recommended by the manufacturer, including frequency of lubrication, lubricants, inspections required, adjustment procedures, belt and pulley sizes, etc.

G. Provide manufacturer's parts bulletins with part numbers for each item of equipment included in the Work. Parts bulletins shall be specific to the equipment

provided. Extraneous information that does not apply to the equipment provided shall be eliminated from the literature.

H. Include copies of test reports (startup, check, etc.) and inspections performed for each piece of equipment provided in the Work.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in ABC's name and registered with manufacturer.

J. Provide supplier and manufacturer contacts, telephone numbers and addresses in the front portion of the operation and maintenance manual.

1.15 PROJECT RECORD DOCUMENTS

A. Provide red-lined drawings accurately showing location of equipment and devices and size and routing of ductwork. Include notes explaining installed condition for complete understanding.

1.16 QUALITY ASSURANCE

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from LP Consulting Engineers, Inc. before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

1.17 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.18 WARRANTY

A. See Section 01700 - Closeout Procedures, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 QUALITY AND CARE

A. All materials shall be new and in perfect condition when installed unless specifically indicated otherwise. Materials shall be tested within the Continental United States by an independent, nationally recognized testing agency and shall be listed in accordance with testing agency requirements. When not otherwise specified, all material shall conform to applicable National Standards (ANSI).

B. All capacities, sizes and efficiency ratings shown on the drawing are minimum.

C. Each category of material or equipment shall be of the same brand or manufacturer throughout the Work wherever possible.
D. The quality of materials and equipment to be provided is defined by the brand names, manufacturers, model and catalog numbers listed on the Drawings and in the Specifications. Contractor shall provide each item listed, of the quality specified, or equal.
E. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
F. Inspect and report concealed damage to carrier within their required time period.
G. Store materials in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect from dirt, water, construction debris, and traffic.
H. Equipment which has been damaged, exposed to weather or is, in the opinion of the Engineer or Owner, otherwise unsuitable because of improper fabrication, storage or installation shall be removed and replaced by this Contractor at his expense.

2.2 ACCESS DOORS

A. Coordinate access door requirements with Section 083113. The more stringent requirements shall govern.
B. Provide access doors where access through floors, walls or ceilings is required to access mechanical, plumbing, control system components, fire dampers and fire alarm system components (such as smoke detectors, fire/smoke dampers, etc.) or other systems requiring access for maintenance, test or observation.
    1. Access doors requiring hand access or access for observation only shall be 14"x14" minimum usable opening.
    2. Access doors where entrance of a service person may be required shall be 24"x30" minimum usable opening.
C. Established standard: Milcor of types listed below. Other acceptable manufacturers: Cesco, J.L. Industries, Karp, Larsen's, or equal. Comply with the following:
    1. Form doors and frames of welded, ground smooth steel construction, 14 gauge for doors, 16 gauge for frames. Provide prime coat finish except for stainless steel type.
    2. Concealed hinges to allow 175 degree opening.
    3. Locks: flush, screw driver operated cam lock(s).
    4. Provide anchoring devices suitable for the construction into which the doors are framed.
D. Application (as applicable):
    1. In gypsum drywall walls and ceilings: Type DW.
    2. In ceramic tile walls: Type MS (stainless steel).
    3. In fire rated walls: Type Fire Rated (rating as required for wall or ceiling), self closing, 250 F in 30 min. temperature rating.

PART 3 EXECUTION

3.1 INSTALLATION

A. Access Doors

1. Coordinate the exact location of access doors to provide proper access to the item concealed. Obtain written approval for access door locations from Architect.
2. Coordinate installation of access doors with the trades performing the construction assemblies into which the access doors are placed.
3. Install all access doors neatly and securely, to open and close completely, and to operate freely and without binding. Install rated doors in accordance with their listing requirements.
4. Test operate all doors and make all adjustments required for satisfactory operation. Replace all damaged materials.
5. Install in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with the requirements within this section.
B. Test all piping with no leak or loss in pressure in accordance with the requirements within this section.

3.3 GENERAL TESTING REQUIREMENTS FOR MECHANICAL AND PLUMBING SYSTEMS

A. Contractor shall assign a responsible person to be an independent representative to witness testing and to sign as witness of times, pressure and losses of testing media for all hydronic piping and duct testing.
   1. Test all piping as noted below with no leak or loss of pressure. Repair or replace defective piping until tests are accomplished successfully.
   2. Submit to the Engineer for review a log of all tests made which shall include time, temperature, pressure, water makeup and other applicable readings, necessary to indicate the systems have been operated and tested in the manner outlined in the construction documents.
   3. After producing the specified test pressure, disconnect the pressurizing source; do not introduce further pressure for the duration of the test period, repair leaky piping and retest. Repeat the procedure until the entire system is proven tight.
B. Test the following systems with the medium listed to the pressure indicated for the time period listed:
   1. Hydronic Piping: Pressure=125 Psig / Medium= Water / Duration=4 Hours.

3.4 CUTTING AND PATCHING

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of ABC or separate Contractor.
B. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in

the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

C. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
E. Restore work with new Products in accordance with requirements of Contract Documents.
F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Code requirements , to full thickness of the penetrated element.
H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.5 PRIMING AND PAINTING

A. Apply primer to all exposed ferrous metals that are not factory primed, factory finished, galvanized, stainless steel or anodized. Exposed black steel piping shall be primed and finish painted to match Architectural finsih requirements.
   1. Primer shall be as recommended by the paint manufacturer for each specific application.
   2. Acceptable Products include: Fuller O'Brien Blox-Rust Metal All Purpose Primer, equivalent Rust-Oleum product, or equal. See Section 092216 for other acceptable products.
B. Apply two coats of primer to metal surfaces of items to be insulated or jacketed, except ductwork and piping, or factory primed or finished.
C. Preparation:
   1. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
   2. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; seal stains and marks which cannot be completely removed using Devoe KILSTAIN primers, shellac, or other coating acceptable to paint manufacturer any marks or defects that might bleed through paint finishes.
   3. Remove mildew from impervious surfaces by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow substrate to thoroughly dry.
   4. Galvanized Surfaces:
      a. Remove surface contamination and oils by solvent cleaning in accordance with SSPC-SP 1 and allow to dry.
      b. Apply Devoe MIRROLAC Galvanized Metal Primer in accordance with manufacturer instructions.
   5. Uncoated Steel And Iron Surfaces:
      a. Remove grease, rust, scale, and dust from steel and iron surfaces using solvent in accordance with SSPC-SP 1.

b. Where heavy coatings of scale or contaminants are evident, hand tool clean in accordance with SSPC-SP 2 or use other approved SSPC SP method as needed.

6. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate Devoe MIRROLAC metal primer or primer recommended by manufacturer.

D. Application:
1. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
2. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
3. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

E. Finish Painting: See Section 09900.

3.6 STARTING EQUIPMENT AND SYSTEMS/COMMISSIONING

A. Start equipment and systems in accordance with manufacturer's written instructions..
B. Adjust for proper operation within manufacturer's published tolerances.
C. Demonstrate proper operation of equipment to ABC's designated representative.
D. Description:
1. Comply with all start up of mechanical and electrical equipment systems as required in the various sections and herein.
2. Coordinate all testing and startup procedures with all other trades so that all non-mechanical and non-electrical work is completed and operational so that the specified testing can be performed.

E. Preliminary Work:
1. Prior to the startup, the Contractor shall ensure that the systems are ready to operate, and the following items have been completed and checked including but not limited to:
a. Proper motor and pump rotation.
b. Flushing and cleaning of the system.
c. Wiring
d. Auxiliary connections
e. Lubrication.
f. Venting.
g. Controls.
h. Installation of filters and strainers.
i. Setting of relief and safety valves .
2. All electrical testing must be completed and test results submitted before equipment startup to avoid power interruptions during mechanical equipment startup and testing.
3. The Contractor shall submit at least 10 days in advance a schedule listing the date of completion of his work as it will be ready for equipment startup of

Electrical/Mechanical equipment. This schedule shall include work on a system by system, floor by floor basis.

4. Two weeks prior to the startup of any major equipment, the Contractor shall certify in writing that the systems will be complete and ready for startup. Completeness shall not only include physical installation of individual pieces of equipment, but all related elements of other crafts to make all equipment operate as a system.
   a. The startup checklist will cover all related crafts, e.g., controls, electrical, mechanical, and a clean environment for equipment startup.
5. The Contractor shall schedule a tour with the Owner's representative and the Engineer to review startup conditions prior to equipment startup. This tour shall take place during the associated Engineer's regularly scheduled visit. This tour does not relieve the Contractor of any responsibilities to properly start equipment. The Engineer will issue a notice of deficiencies that will be required to be corrected prior to equipment startup. The Contractor will be required to reschedule a back check with the Engineer prior to attempting an equipment startup.
6. Equipment of systems should not be started until systems and associated subsystems are completed. Verify that other continuing work could not possibly damage completed systems if they are in operation. Furnish signed off prestartup check sheet.

F. Startup and Commissioning:
   1. System Startup and Operation:
      a. The Contractor shall provide all labor, materials and services necessary for the initial startup and operation of all systems and equipment furnished and installed under this section.
      b. The Contractor and the factory representative shall check all equipment during initial startup to insure correct rotation, proper lubrication, adequate fluids or air flows, nonoverloading electrical characteristics, proper alignment and vibration isolation. Systems shall be checked for air and/or water flows throughout without blockages. Air handling systems shall be checked for proper damper connections and positions, aligned and adjusted belt drives, proper lubrication, temporary air filters installed, nonexcessive electrical characteristics and minimal vibration. Other miscellaneous equipment shall be started and operated as described above as applicable. Manufacturer's representative shall submit a preliminary written copy of equipment startup check sheet prior to leaving job site.
      c. After initial startup and operation of systems, the Contractor shall submit a report, showing proper operation before commencement of the final "Operation Test".
      d. During initial operation of the system and until substantial completion, qualified personnel shall be provided and designated for maintaining the equipment and systems in good running order. Items such as strainers, cleanouts, filter replacement, bearing lubrication, packing replacement, and other consumables shall be provided without cost to the Owner. Failure of equipment during this period due to lack of proper supervision is the responsibility of the Contractor and continued failures shall be grounds for

the Owner to provide such services with back charges to the Contractor. Submit written schedule of completed maintenance to the Engineer.

G. System Acceptance:
   1. General: The system installation shall be complete and tested for proper operation prior to acceptance testing "Operation Test" for the Owners authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify that all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing shall commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative and pass, the system will be accepted. The warranty period may begin at this time.

H. Operation Test:
   1. Provide all labor, equipment, and materials required to perform test.
   2. The test shall occur after all major equipment startup and balance services have been performed as specified. The purpose is to demonstrate that individual pieces of equipment and all related elements operate as one complete system and not to identify incomplete or defective work.
   3. All equipment is to be run in an automatic operating position and exercised for 72 hours to verify that they perform in accordance with the specified sequence of operation and designed operation logic.
   4. The Engineer's representative shall be notified and may be present for the initiation of the test.
   5. A log shall be prepared by the Contractor, to be submitted to the Engineer, of all tests including, but not limited to: time, temperatures, pressures, and other readings to prove all equipment is operating as specified.
   6. All temperatures, pressures, status indication, etc., shall be verified by at least one other means of measurement or visual verification of condition.
   7. Change set points and simulate conditions as directed to demonstrate:
      a. Ability to control to new set point.
      b. Interface between systems, fire alarm/fire sprinkler systems.
      c. Proper sequence and operation.
      d. Equipment safety systems and all automatic changeover/backup systems and alarms are functioning or will function.
   8. If unsatisfactory performance or a system failure is experienced for any reason, the test shall be repeated until 72 hour consecutive hours are achieved. The Engineer's representative shall make all final decisions of a satisfactory test.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Strut systems for pipe or equipment support.
B. Beam clamps.
C. Pipe hangers.
D. Pipe rollers and roller supports.
E. Pipe supports, guides, shields, and saddles.
F. Seismic bracing hardware.
G. Nonpenetrating rooftop supports for low-slope roofs.
H. Anchors and fasteners.

1.2 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2022.
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).
F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
N. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
C. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of mechanical work.
B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
E. Fire Resistance: Provide hardware rated for 120 minutes resistance unless specifically indicated by the authority having jurisdiction.
F. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.
    1. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
    1. Indoor Dry Locations: Use approved equivalent or galvanized steel unless otherwise indicated.
    2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.2 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:
    1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
    2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
B. Hanger Rods:
    1. Threaded zinc-plated steel unless otherwise indicated.
    2. Minimum Size, Unless Otherwise Indicated or Required:

a. Equipment Supports: 1/2 inch diameter.
b. Piping up to 4 inch: 3/8 inch diameter.
c. Piping larger than 4 inch: 1/2 inch diameter.
d. Trapeze Support for Multiple Pipes: 3/8 inch in length.

C. Channel Nuts:
1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.3 BEAM CLAMPS

A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
B. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
C. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.4 PIPE HANGERS

A. J-Hangers, Adjustable:
1. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
2. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
B. Swivel Ring Hangers, Adjustable:
1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
C. Clevis Hangers, Adjustable:
1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
2. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
3. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
4. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.5 PIPE CLAMPS

A. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
B. Extension Split Pipe Clamp:
1. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
2. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
3. Provide hanger rod and nuts of the same type and material for a given pipe run.

4. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

D. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
2. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.

E. Insulation Coupling:
1. Two bolt-type clamps designed for installation under insulation.
2. Material: Carbon steel with epoxy copper or zinc finish.

2.6 PIPE ROLLERS AND ROLLER SUPPORTS

A. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

B. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.

C. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.7 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Stanchions:
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

C. U-Bolts:
1. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.

D. Pipe Alignment Guides, Galvanized steel:
1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
2. Pipe Sizes 10 inch and Larger: Roller type.

E. Pipe Shields for Insulated Piping:
1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
2. General Construction and Requirements:
a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
b. Shields Material: UV-resistant polypropylene with glass fill.
c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
d. Service Temperature: Minus 40 to 178 degrees F.
e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

F. Pipe Supports:

1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F:
   a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
   b. Support From Below: MSS SP-58 types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
   b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 types 35 through 38.

G. Pipe Supports, Thermal Insulated:
1. General Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
   c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
   d. Provide pipe supports for 1/2 to 30 inch iron pipes.
   e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
2. PVC Jacket:
   a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
   b. Minimum Service Temperature: Minus 40 degrees F.
   c. Maximum Service Temperature: 180 degrees F.
   d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   e. Minimum Thickness: 60 mil, 0.06 inch.

2.8 SEISMIC BRACING HARDWARE

A. Cable Sway Bracing Systems:
1. Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
2. Provide cable wire and end-fixing as required to hold minimum weight of 100 lb.

B. NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

C. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

D. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
G. ANCHORS AND FASTENERS
H. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
I. Concrete: Use preset concrete inserts or expansion anchors.
J. Solid or Grout-Filled Masonry: Use expansion anchors.
K. Hollow Masonry: Use toggle bolts.
L. Hollow Stud Walls: Use toggle bolts.
M. Steel: Use beam clamps, machine bolts, or welded threaded studs.
N. Sheet Metal: Use sheet metal screws.
O. Wood: Use wood screws.
P. Plastic and lead anchors are not permitted.
Q. Powder-actuated fasteners are not permitted.
R. Hammer-driven anchors and fasteners are not permitted.
S. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
T. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    1. Channel Material: Use galvanized steel.
    2. Manufacturer: Same as manufacturer of metal strut channel framing system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
D. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.
E. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.
F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
H. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
J. Secure fasteners according to manufacturer's recommended torque settings.
K. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.
B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

1.2 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.

PART 3 EXECUTION

2.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
C. Secure fasteners according to manufacturer's recommended torque settings.
D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

2.2 INSTALLATION - GENERAL

A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
D. Coordinate work with other trades to avoid rigid contact with the building.
E. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.
F. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense

2.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.
C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Pipe markers.
D. Ceiling tacks.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.
B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Product Data: Provide manufacturers catalog literature for each product required.
D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.
B. Air Terminal Units: Nameplates.
C. Control Panels: Nameplates.
D. Dampers: Ceiling tacks, where located above lay-in ceiling.
E. Heat Transfer Equipment: Nameplates.
F. Major Control Components: Nameplates.
G. Piping: Pipe markers.
H. Pumps: Nameplates.
I. Small-sized Equipment: Tags.
J. Tanks: Nameplates.
K. Thermostats: Nameplates.
L. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Seton Identification Products: www.seton.com/aec.

2.3 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: Air Handling Units, Control panels: 1 inch.
   3. Letter Height: All others: 1/4 inch.
   4. Background Color: Black.
   5. Plastic: Comply with ASTM D709.

2.4 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.5 PIPE MARKERS

A. Color: Comply with ASME A13.1.
B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Secure to pipe using two (2) bands of adhesive tape with flow arrows supplied by the manufacturer. Install securing bands completly around pipe and overlapped.
C. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

2.6 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.
B. Color code as follows:
   1. Fire Dampers and Smoke Dampers: Red.
   2. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
B. Install tags with corrosion resistant chain.
C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
D. Identify fans and filter boxes with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
E. Identify chilled/hot water equipment, including chillers, boilers, pumps, expansion tanks, air separators, etc. with plastic nameplates.

F. Identify air conditioning units, air handling units, heating and ventilating units, exhaust fans, pumps, heat transfer equipment, tanks, fire/smoke damper access doors, and water treatment devices with nameplates. Small devices, such as terminal units, in-line pumps, may be identified with tags.
G. Identify control panels and major control components outside panels with plastic nameplates.
H. Identify thermostats/sensors relating to fan unit and/or zone unit with nameplates.
I. Identify valves in main and branch piping with tags.
J. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
K. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.
B. Commissioning activities.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

1.3 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).
C. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems 2019.
D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component and include controls contractor to assist in testing, adjusting, and balancing procedures. Submit plan for each phase.
    1. Submit to LP Consulting Engineers, Inc..
    2. Submit to the Commissioning Authority.
    3. Submit four weeks prior to starting the testing, adjusting, and balancing work.
    4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the LP Consulting Engineers, Inc. and other installers to sufficiently understand the design intent for each system.
    5. Include at least the following in the plan:
        a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
        b. List of all air flow measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
        c. Completed planned test sheets listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
        d. Single-line drawings with system test locations.

e. Identification and types of measurement instruments to be used and their most recent calibration date.
f. Detailed step-by-step procedures for TAB work for each system and issue, including:
   1) SA, RA, EA, OA, for each AHU.
   2) Economizer proportioning and vfd speed adjustiments.
   3) Rechecking.
g. Confirmation of understanding of the outside air ventilation criteria under all conditions.
h. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
i. Method of checking building static and exhaust fan and/or relief damper capacity.
j. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit to LP Consulting Engineers, Inc. within 2 days after completion of testing, adjusting, and balancing.
   2. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   3. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   4. Units of Measure: Report data in I-P (inch-pound) units only.
   5. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE Std 111, or NEBB forms.
   6. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.
      d. Project name.
      e. Project location.
      f. Project Engineer.
      g. Project altitude.
      h. Report date.

D. Test and balance shall be performed by an independent test and balance agency.
E. Perform total system balance in accordance with AABC MN-1, ASHRAE Std 111, or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
F. TAB Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience certified by AABC or NEBB.
G. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work and licensed at the .

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
   3. SMACNA (TAB).
B. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
C. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
      b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 TESTING, ADJUSTING, AND BALANCING AGENCIES

A. RS Analysis Inc.; www.rsanalysis.com; (888-330-1935).
B. Mesa 3; www.mesa3.com; (408-928-3000).
C. Raglen System Balance; www.raglensystembalance.com; (775-747-0100).

3.3 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   4. Duct systems are clean of debris.
   5. Fans are rotating correctly.
   6. Fire and volume dampers are in place and open.
   7. Air coil fins are cleaned and combed.
   8. Access doors are closed and duct end caps are in place.
   9. Air outlets are installed and connected.
   10. Hydronic systems are flushed, filled, and vented.
   11. Pumps are rotating correctly.
   12. Proper strainer baskets are clean and in place.

13. Service and balance valves are open.

B. Contractor to inspect ductwork and piping systems at 60% and 90% completion to verify systems are ready for testing and balancing.
C. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
D. Beginning of work means acceptance of existing conditions.

3.4 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to LP Consulting Engineers, Inc. to facilitate spot checks during testing.
B. Provide additional balancing devices as required.

3.5 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust total airflow(s) to within plus 10 percent and minus 5 percent of design.
B. Air Outlets and Inlets: Adjust outlets and inlets in space to within plus 10 percent and minus 5 percent of design.
C. Hydronic Systems: Adjust to within plus 10 percent and minus 5 percent of design.

3.6 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.
B. Ensure recorded data represents actual measured or observed conditions.
C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by ABC.

3.7 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
C. Measure air quantities at air inlets and outlets.
D. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
E. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

F. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
G. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.8 TITLE 24 TESTING

A. Complete applicable Title 24 Acceptance Testing as delineated in contract drawings.

3.9 COMMISSIONING

A. See Division 1, 22, 23 and 26 Commissioning specifications for requirements. Coordinate all requirements with Commissioning Agent.
B. Perform prerequisites prior to starting commissioning activities.
C. Assist Commissioning Agent in field verification of test and balance report.
D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

3.10 SCOPE

A. Test, adjust, and balance the following:
   1. Air Handling Units.
   2. Fans.
   3. Air Filters.
   4. Air Inlets and Outlets.

3.11 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.
B. Cooling Coils:
   1. Location.
   2. Service.
   3. Manufacturer.
   4. Air flow, design and actual.
   5. Entering air DB temperature, design and actual.
   6. Entering air WB temperature, design and actual.
   7. Leaving air DB temperature, design and actual.
   8. Leaving air WB temperature, design and actual.
   9. Saturated suction temperature, design and actual.
   10. Air pressure drop, design and actual.
C. Air Moving Equipment:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

D. Return Air/Outside Air/Exhaust Air:
1. Identification/location.
2. Design air flow (determined by inital test)
3. Actual air flow.
4. Design return air flow (determined by inital test)
5. Actual return air flow.
6. Design outside air flow (determined by inital test)
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Actual mixed air temperature.

E. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.
B. Duct liner.
C. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 31 00 - HVAC Ducts and Casings: Ductwork.

1.3 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation 2020.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.

1.5 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. See Section 013300 - Submittals, for submittal procedures.

C. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
D. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Owens-Corning Fiberglas; Model [All Service Faced Duct Wrap].
   2. Knauf Insulation: www.knaufinsulation.com.
   3. Johns Manville: www.jm.com/#sle.
B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Duct Application: 2" thick, 3/4 pound density.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.
C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure-sensitive tape.
D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.3 GLASS FIBER, RIGID

A. Manufacturer:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Knauf Insulation: www.knaufinsulation.com.
   3. Johns Manville: www.jm.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 450 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent.
   4. Density: 3.0 lb/cu ft.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Secure with pressure-sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.4 JACKETING AND ACCESSORIES

A. Aluminum Jacket:
   1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
   2. Thickness: 0.020 inch sheet.
   3. Finish: Embossed.
   4. Joining: Longitudinal slip joints and 2 inch laps.
   5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
   6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.5 DUCT LINER

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Knauf Insulation: www.knaufinsulation.com.
   3. Johns Manville: www.jm.com/#sle.
   4. Owens Corning Corp: www.owenscorning.com.

B. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket; impregnated surface and edges coated with acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
   1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
   2. Duct Application (Indoors): 1" thick, 1-1/2 pound density.
   3. Duct Application (Outdoors): 2" thick, 1-1/2 pound density.
   4. Service Temperature: Up to 250 degrees F.
   5. Acoustical Requirements

a. Sound absorption coefficients of the material (with and/or without erosion resistive coating) shall be greater than or equal to the coefficients listed in the specifications when tested under the specified conditions.
b. All acoustical measurements shall be performed in accordance with ANSI/ASTM C423 and shall be performed in the ASTM E795 mounting configuration as indicated.
c. An independent acoustical laboratory shall perform the tests.
d. The sound absorption coefficient provided by the material shall meet or exceed the following values in each octave band listed:

6. Thickness, 1 inch Hz/Coefficient: 125/.05, 250/.20, 500/.65, 1k/.90, 2k/.95, 4k/.95.

C. Liner Fasteners: Galvanized steel, welded with integral head.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.
B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Insulated Ducts Conveying Air Below Ambient Temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or with standard vapor barrier jacket.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Liner shall start within 3 inches of the upstream transverse edges of the liner and 3 inches from the longitudinal joints, and shall be spaced at a maximum of 12 inches on center around the perimeter of the duct (except that they shall be a maximum of 12 inches from a corner break). Elsewhere, they shall be a maximum of 18 inches on center, except that they shall not be placed more than 6 inches from a longitudinal joint of the liner or 12 inches from a corner break. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for spacing.
3. Seal and smooth joints. Seal and coat transverse and longitudinal joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are inside dimensions and do not include consideration for liner thickness.

3.3 SCHEDULES

A. Supply and Return Ducts: Insulate all unlined supply ducts, except ducts exposed in conditioned spaces.
B. Exterior Applications:
   1. Supply and Return Ducts exposed to outdoors to be internally lined except ductwork conveying direct evaporatively cooled air.
   2. Supply and Return ductwork exposed to outdoors for direct evaporatively cooling systems to be externally insulated. Cover insulation with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
C. Supply and Return Ducts: Install lining on ductwork and plenums where shown or noted on drawings.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.
B. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
C. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.
C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.
D. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing 2022.
E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.
B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER, RIGID

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufusa.com.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
B. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible.
   1. "K" value: ASTM C 177:
      a. 0.24 to 0.28 at 100 degrees mean rating temperature.
      b. 0.25 to 0.29 at 125 degrees mean rating temperature.
      c. 0.27 to 0.30 at 150 degrees mean rating temperature.
      d. 0.29 to 0.31 at 200 degrees mean rating temperature.
      e. 0.32 to 0.34 at 250 degrees mean rating temperature.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.
C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
D. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Armacell LLC: www.armacell.us/#sle.
   2. K-Flex USA LLC: www.kflexusa.com/#sle.
B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.
C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
E. Insulation Exposed to the Weather: Finish with two coats Armstrong white Armaflex finish. Provide aluminum jacketing.

2.4 JACKETING AND ACCESSORIES

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil, 0.010 inch.
      e. Connections: Brush on welding adhesive.
B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Embossed.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert material: Pipe saddle.
C. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

3.3 SCHEDULE

A. Heating Systems:
   1. Heating Water Supply and Return:
      a. Glass FIber Insulation:
         1) Pipe Size Range: 1 inches and smaller.

(a) Thickness: 1-1/2 inch.
2) Pipe Size Range: 1-1/2 inches and larger.
(a) Thickness: 2 inch.

B. Cooling Systems:
1. Chilled Water:
a. Glass Fiber Insulation:
1) Pipe Size Range: 1 inches and smaller.
(a) Thickness: 1 inch.
2) Pipe Size Range: 1-1/2" and larger.
(a) Thickness: 1-1/2 inch.
2. Refrigerant Suction:
a. Flexible Elastic Cellular Insulation:
1) Pipe Size Range: 3/4 inch and smaller.
(a) Thickness: 1 inch.
2) Pipe Size Range: 1 inch and larger.
(a) Thickness: 1.5 inch.
3. Refrigerant Hot Gas:
a. Flexible Elastic Cellular Insulation:
1) Pipe Size Range: 3/4 inch and smaller.
(a) Thickness: 1 inch.
2) Pipe Size Range: 1 inch and larger.
(a) Thickness: 1.5 inch.

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 : GENERAL

1.1 WORK INCLUDED

A. Furnish a native BACnet Energy Management System (EMS) as specified herein. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2016, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
B. The native BACnet EMS shall be as specified herein and consist of a high-speed, peer-to-peer local area network of DDC controllers connected to a dedicated Server PC and other client workstation PC's and Lap Top computers as specified. All HVAC and/or Electrical system points monitored and controlled by the EMS, including the building floor plans as well as all control devices, will be depicted by point-and-click graphics.
C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers. All controller devices must be BTL tested and listed by the official BACnet Testing Laboratory, having the BTL approval mark issued with Rev 15 or later listing for the MS/TP devices.
D. All devices in this new project facility location shall be accessible from a single graphical user interface.
E. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
F. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
G. Furnish and install the required software to produce a complete and operational native BACnet EMS as specified herein.
H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
I. Provide a comprehensive operator and technician training program as described herein.
J. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Products Supplied but Not Installed Under This Section: NONE
B. Products Installed but Not Supplied Under This Section: None.
C. Products Not Furnished or Installed but Integrated with the Work of This Section:
   1. LIGHTING CONTROLS SYSTEMS

D. Work Required Under Other Divisions Related to This Section:
   1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
   2. Provision and wiring of smoke detectors and devices relating to fire alarm system.
   3. Campus LAN (Ethernet) connection adjacent to Operator Workstation.

1.3 SPECIFICATION NOMENCLATURE AND DEFINITIONS

A. Acronyms Used in this Specification:
   1. Actuator: Device that opens or closes valve or damper in response to control signal.
   2. Analog: Continuously variable state overstated range of values.
   3. AWS: Advance Workstation
   4. BAS: Building Automation System.
   5. Compass: Alerton Workstation Software.
   6. DDC: Direct Digital Control.
   7. HVAC: Heating, Ventilating and Air Conditioning.
   8. LAN: Local Area Network.
   9. Modulating: Movement of control device through a range of values, proportional to an infinitely variable input value.
   10. Motorized: Control device with actuator.
   11. Operator Workstation: PC running Compass software and any required software tools applicable for day to day operation of the BMS.
   12. PICS: BACnet Product Interoperability Compliance Statement.
   13. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
   14. Point: Analog or discrete instrument with addressable database value.
   15. WAN: Wide Area Network.

1.4 SYSTEM DESCRIPTION

A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2016, BACnet and achieved listing under the BACnet Testing Laboratories BACnet - Advanced Workstation Software (B-AWS). This system is to control all mechanical equipment, including all unitary equipment such as heat pumps, fan-coils, AC units, etc., and all air handlers, boilers, cooling towers, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.

B. Operator’s workstation software shall be 64-bit operating system running Windows 10 as the computer operating system. The Energy Management System (EMS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, and a full suite of field engineering tools including graphical programming and applications. Systems

using operating systems other than that described above are strictly prohibited. All software required to program EMS application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system, along with scheduling and trending applications, will be left with the owner. All software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools, including graphical programming and applications will be left with the owner.

C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.

D. All application controllers for every terminal unit (HP, UV, etc.), air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet LAN.

E. Lighting Control System:
   1. Lighting controls specified to be integrated to the BAS are to be supplied with appropriate BACNet MS/TP or BACnet IP Open Protocol translator for integration to Alerton BAS.
   2. Lighting controls to be integrated to the BAS, to be provided with a BACNet MS/TP or BACNet IP interface and all necessary software. Equipment Supplier providing all necessary onsite programming / technical support to ensure both systems are communicating, and all points are mapped and interactive between systems in conjunction with BAS Contractor.
   3. Point availability from and specific sequences of operation and controllability of Equipment with Manufacturer provided controls is limited by Manufacturer. Controls contractor does not have the ability to modify Equipment Manufacturer sequences.
   4. Controls contractor shall excludes all communication gateways to 3rd party interface devices. They must be provided and configured by the manufacturer

F. VRF:
   1. VRF specified to be integrated to the BAS are to be supplied with appropriate BACNet MS/TP or BACnet IP Open Protocol translator for integration to Alerton BAS.
   2. VRF to be integrated to the BAS, to be provided with a BACNet MS/TP or BACNet IP interface and all necessary software. Equipment Supplier providing all necessary onsite programming / technical support to ensure both systems are communicating, and all points are mapped and interactive between systems in conjunction with BAS Contractor.

3. Point availability from and specific sequences of operation and controllability of Equipment with Manufacturer provided controls is limited by Manufacturer. Controls contractor does not have the ability to modify Equipment Manufacturer sequences.
4. Controls contractor shall excludes all communication gateways to 3rd party interface devices. They must be provided and configured by the manufacturer

G. System Architecture
1. Connection between all Integration Level Global Controllers, the BACnet Server and any client work stations (PC's or Lap Tops) shall be high-speed, peer-to-peer Ethernet as per Standard IEEE802.3. Owner shall furnish and maintain IT WAN infrastructure.
2. EMS Contractor shall provide and install a dedicated MS/TP LAN extending from all Global Controller's to distributed field level controller BACnet devices.
3. Distributed field level controllers are responsible for directly controlling and monitoring HVAC and Electrical system points throughout the facility.
4. The BACnet Server hosts system configurations, programming databases and stores all trend log data. The Server maintains all backup files for system configuration and programming located on Global Controller's and field level controllers and is capable of directly uploading or downloading information from the controllers.
5. An operator's workstation and/or any designated portable operator's terminal (if specified) shall be used as a graphical user interface to provide system supervision, management report generation and alarm annunciation.

1.5 APPROVED MANUFACTURERS

A. Approved Control Manufacturers:
1. Alerton – Ascent Compass – Contact Torrey Plana at Syserco: 510-673-5610 or e-mail: t.plana@syserco.com.

B. Owner and Owner's Representative reserves the right to approve and/or deny qualification status of all potential bidders based upon references and compliance with Specifications and Contract Documents.

1.6 QUALITY ASSURANCE

A. The Contractor shall be regularly engaged in the manufacturing, installation and maintenance of EMS systems and shall have demonstrated technical expertise and experience in the manufacture, installation and maintenance of EMS systems similar in size and complexity to this project.

B. The EMS system shall be designed, installed, commissioned, and serviced by manufacturer-authorized and trained personnel. System provider shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.

C. To provide the level of support and response required by the Owner, the Energy Management System Contractor shall have a fully staffed service. 24/7 Service Call Center staffed by live operators enabling immediate response to Owner's critical emergency EMS concerns.

D. EMS Contractor shall have a proven record of successful native BACnet installations and maintenance of equivalent native BACnet systems for a minimum period of 5 years

utilizing the same native BACnet manufacturer's product line that the Contractor proposes to use on this project.

E. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
F. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
G. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

1.7 DELIVERY, STORAGE AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instruction and recommendations.
B. Protect from damage due to weather, excessive temperature and construction operations.

1.8 REFERENCE STANDARDS

A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   2. ANSI/ASHRAE Standard 135-2016, BACnet.
   3. Uniform Building Code (UBC), including local amendments.
   4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
   5. National Electrical Code (NEC).
   6. FCC Part 15, Subpart J, Class A.
   7. EMC Directive 89/336/EEC (European CE Mark).
   8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.
B. City, county, state, and federal regulations and codes in effect as of contract date.
C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

1.9 SUBMITTALS

A. Drawings
   1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
   2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
   3. Eight (8) complete sets (copies) of submittal drawings shall be provided.
   4. Drawings shall be available on CD-ROM.
B. System Documentation
   1. Include the following in submittal package:
   2. System configuration diagrams in simplified block format.
   3. All input/output object listings and an alarm point summary listing.

4. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
5. Complete bill of materials, valve schedule and damper schedule.
6. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
7. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
8. For all system elements—operator's workstation(s), building controller(s), application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2016.
9. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
10. A list of all functions available and a sample of function block programming that shall be part of delivered system.

1.10 WARRANTY

A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one (1) year from completion of system acceptance.
B. Extended Warranty – Years 2 to 5. For Characterized Control Valves (CCV), Globe Valves, Butterfly Valves, associated Valve Actuators and Damper Actuators, provide like kind replacement components for any defective material identified and returned in Years 2 to 5 from the date of production.
C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor.
D. This warranty shall apply equally to both hardware and software.

1.11 RELATED WORK IN OTHER SECTIONS

A. Refer to Division 0 and Division 1 for related contractual requirements.
B. Refer to Section 23 00 00 for General Mechanical Provisions.
C. Refer to Section 26 00 00 for General Electrical Provisions.

PART 2 : PRODUCTS

2.1 ADVANCED WORKSTATION (EXISTING)

A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database for the BACnet network as specified in these contract document Specifications and project Plan Drawings. Thick and Web Clients shall access server for all archived data. Server shall support a minimum of 20 simultaneous clients.
B. BACnet Conformance
    1. Operator workstation shall be approved by the BTL as meeting the BACnet Advanced Workstation (AWS) requirements.
    2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal

data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
4. The AWS shall comply with Annex J of the BACnet specification for IP connections. Must support remote connection to server using a thick client application. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

C. Data Displays

1. Data displays shall render all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings.
2. Data displays shall render all data using iconic graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user.
3. Data display frame shall allow user to change all field-resident AWS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic.
5. All displays and programming shall be generated and customized by the local EMS Contractor. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
6. AWS shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. AWS shall include a library of equipment graphic components to assemble custom graphics. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.
7. Data display frame shall include customizable and persistent tree navigation for building, equipment and system diagnostic centric display organization.
8. Each display may be protected from viewing unless operator credentials have the appropriate access level. An access level may be assigned to each display and

system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

9. Data displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a Web browser resolving to a specified Web address.
10. Data displays shall support:
    a. Graphic items with custom geometry that offer both color gradient shading and variable opacity in scale to system variables and range set points.
    b. Clear and custom geometry navigation buttons to provide intuitive navigation.
    c. Graphic files in jpg, png, and .gif file types.
    d. Viewing of 1,024 system data points in a single screen.
11. All graphical user interface screens developed for Thick or Web Client devices on this project shall be seamlessly integrated to the existing Alerton Ascent Compass Server PC by the EMS Contractor. Graphical user interface screens for this project requiring software enabling/support beyond Alerton Ascent Compass are specifically prohibited.

D. Password Protection
1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. AWS shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0–8 characters, User Name shall be 0–29 characters, and Password shall be 4–8 characters long.
3. Each user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well restricted access to discrete BACnet devices to which that user requires access.
4. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal.
5. Users shall also have a set access level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct access levels for assignment to users.
6. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
7. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log
1. Operator Activity Log that tracks all operator changes and activities shall be included with AWS. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity,

sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.

2. Log shall be gathered and archived to hard drive on AWS as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. User option to enter a comment in Operator Activity Log upon system point change. Option to enforce user comment in order to complete system point change.
4. Operator Activity Log is accessible via right mouse click and selection from web client context menu.

F. Scheduling

1. AWS and Web Client shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate access privileges.
4. AWS shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.
7. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.
8. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule allow the point to be scheduled.
9. Schedule editor shall support Drag-n-drop events and holidays onto the schedule calendar.
10. Schedule editor shall support Drag-n-drop events default to a 2hr period; which can then be adjusted by the user.

11. Schedule editor shall support Drag-n-drop holidays are defaulted for OFF all day and can be edited for multiple-day holidays.
12. Schedule editor shall support the View of affected zones when adding or editing timed events of a schedule.

G. Advanced Scheduling:
1. Hierarchy of schedulable resources shall be customized to meet owner/operator specific scheduling needs and requirements.
2. Schedulable resources shall support analog and binary data points, e.g. AV, AO, BV, BO objects.
3. Each schedulable resource shall have its own unique schedule object.
4. Holiday schedules shall support definition of a specific date or a perpetual holiday with a duration, for example the USA Thanksgiving two-day holiday.
5. Calendar events set to be reoccurring events shall support the following recurrence patterns:
   a. Repeat daily every x days or every weekday
   b. Repeat weekly every x weeks on selected days of the week
   c. Repeat monthly every x months on a specific date of the month or a specific day such third Saturday or last Monday.
   d. Repeat yearly every x years on a specific month and date or a specified day of a specified month, e.g. last Wednesday of November
6. Calendar events set to be reoccurring events shall support the following recurrence ranges: no end date, end after x occurrences, and end by a specified date.
7. Calendar events set to be reoccurring events shall support a custom recurrence setting that is a collection of specified random dates that may have no logical pattern.
8. Calendar events shall be configurable as a template that allows quick reuse and application by drag-and-drop onto any resource calendar. Any event shall be capable of being made into an event template.
9. Calendar events shall require the following parameters: Event Name, Event Type (binary or setpoint), Start Date/Time, and End Date/Time.
   a. Analog Event Type shall support selecting setpoint type to ensure that only compatible analog points are scheduled with a specified value
10. Calendar Events shall support selection of schedulable resources by inheritance to all child resources or by selection of specific resources. Each selected resource shall support setting a start and end offset of +/- 6 hours from event start start/end times.
11. The following conflict resolution rules shall be provided to determine what to do when schedulable resources have two events scheduled for the same time: Local vs. Inherited event; On vs. Off event; Newest vs. oldest event.

H. Alarm Management
1. AOWS shall provide visual, printed, and email means of alarm indication. Printout of alarms shall be sent to the assigned network printer. Alarm notification can be filtered based on the User ID’s authorization level.
2. Alarm Manager shall provide log of alarm messages. History of alarm occurrences shall be archived to the data storage of the AOWS or a SQL data base. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256

characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, identification of operator acknowledging alarm, a comment form the operator who acknowledged the alarm, and the number of alarm occurrences.

3. Alarm Manager shall provide a means to filter all alarms that have been configured in the system for alarm description, current alarm state, default and customer date range, disabled/enabled, and priority level.
4. Alarm Manager shall provide a means to disable alarms for the purpose of performing maintenance without creating concern with unneeded alarm notifications.
5. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the AOWS user interface or through remote communication using email (Authenticated SMTP supported).
6. Alarm Manager shall provide the permissioned ability to Clear alarm occurrences from the Alarm Manager table while retaining the alarm in the AOWS database for reporting purposes.
7. Alarm Manager shall provide the permissioned ability to Purge alarm occurrences from the both the Alarm Manager table and the AOWS database.
8. Alarm Manager shall provide a user customizable navigation link from the Alarm message to the data display or template to the equipment associated with the alarm.
9. Alarm Manager shall provide a context menu that will allow for navigation to Schedule, Trendlog, Object Property display, or System (user) Activity from the Alarm points live data value.
10. AOWS shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
11. User can silence audible annunciation for the current session.
12. User can disable auto-refresh of alarm annunciation for current session.
13. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or allow the creation of a new alarm.
14. Alarm Priority Levels (0-127) shall be definable in number and name. Alarms can be assigned to any of the priority levels defined.
15. The following Alarm data shall be displayed in the Alarm Management User Interface for each alarm:
    a. Number of times the alarm has occurred
    b. Average alarm duration (hours, minutes, and seconds) for the following transitions:
        1) Active to Normal
        2) Active to Acknowledgement
        3) Acknowledgement to Normal
    c. Actual alarm duration (hours, minutes, and seconds) for the following transitions for each alarm occurrence:
        1) Active to Normal
        2) Active to Acknowledgement

3) Acknowledgement to Normal
d. Live data point of point alarmed
e. Navigation link to a user-selected display or URL

16. User Comment text shall be entered upon acknowledgement of an Alarm. The comment history is stored in the system data base and a user cannot edit or delete a comment after it has been submitted in the system.
17. Alarm Performance: An alarm annunciation shall appear on the AOWS user interface within 8 seconds and appear in the Alarm manager and data base within 10 seconds of a triggered alarm.

I. Trend log Information
1. AWS shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the web client. Operator shall be able to view all trended records, both stored and archived. All trend log records shall be displayed in standard engineering units.
2. AWS shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. AWS shall be able to change Trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All operations shall be password protected. Viewing may be accessed directly from any and all graphics on which a trended object is displayed.
4. AWS shall include a Trend log Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right-clicking on value displayed on graphic, and then selecting Trend logs from the displayed menu.
5. AWS shall be capable of using Microsoft SQL as the system database.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trend log shall then be selectable on the screen. Selection of the trend log using this method shall allow the viewing of the trend log view.
7. Trend log viewer shall provide:
   a. Software that is capable of graphing the trend logged object data shall be included.
   b. Access and ability to create, edit and view are restricted to users by user account credentials
   c. Specific and repeatable URL defines the trend log(s) that comprise the view
   d. Call out of trend log value at intersection of trend line and mouse-over vertical axis.
   e. Trend log and companion logs can be configured to display on one of two independent vertical scales.
   f. Click zoom for control of data set viewed along either graph axis.
   g. User specifiable start and end dates as well as a fast scroll features that that supports click zoom of macro scale view of the data for quickly finding data set based on visual signature.
   h. User export of the viewed data set to MS Excel.

i. Web browser based help
j. Optional min/max ranges (Upper Control Limits, Lower Control Limits) for each value.

J. Energy Log Information – As Scheduled
1. AWS shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
2. All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. AWS Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. AWS shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

K. Demand Limiting – As Scheduled
1. AWS shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Binary shedding shall include minimum of five (5) priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one, the loads shall be shed/restored in a “first off-first on” mode, and in the other the loads are just shed/restored in a “first off-last on” (linear) fashion.
3. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.
4. AWS shall be able to display the status of each and every load shed program. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

L. Tenant Activity – As Scheduled
1. AWS shall include program that monitors after-hours overrides by tenants, logs that data, and generates a bill based on usage and rate charged for each tenant space. Tenant Activity program shall be able to assign multiple zones, from a list of every zone connected to system, to a particular tenant. Every zone is monitored for after-hour override usage and that data logged in AWS. Operator may then generate a bill based on the usage for each tenant and the rate charged for any overtime use.

2. Configuration shall include entry of the following information for use in logging and billing:
   a. Tenant's contact name and address
   b. One or multiple tenant zones that make up a total tenant space, including a separate billing rate for each separate zone
   c. Minimum and maximum values an event duration and event limit
   d. Property management information
   e. Overall billing rate
   f. Seasonal adjustments or surcharge to billing rate
   g. Billing notification type such including, but not limited to printer, file and email
   h. Billing form template
3. Logging shall include recording the following information for each and every tenant event:
   a. Zone description
   b. Time the event begins
   c. Total override time
   d. Limits shall be applied to override time
4. A tenant bill shall be generated for a specific period using all the entered configuration data and the logged data. User with appropriate security level shall be able to view and override billing information. User shall be able to select a billing period to view and be able to delete events from billing and edit a selected tenant activity event's override time.

M. Reports
1. AWS shall be capable of periodically producing reports of trend logs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.
2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.

N. Configuration/Setup
1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

O. Field Engineering Tools
1. AWS shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and

outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
6. AWS automatically notify the user when a device that is not in the database is added to the network.
7. AWS shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
8. The system shall provide a means to scan, detect, interrogate, and edit third-party BACnet devices and BACnet objects within those devices.

P. Workstation Hardware – As Scheduled
   1. Provide operator's workstation(s) at location(s) noted on the plans.
   2. AWS Server
      a. 64-bit OS Required
      b. Windows 10 Pro or Enterprise or Windows Server 2019
      c. Quad-core or Eight-core processors.
      d. 8 GB RAM or higher.
      e. 500 GB (or higher) hard drive
      f. Network interface card (10/100/1000 Mbps).

Q. Software
   1. Provide 10 concurrent "Thick Client" Engineering Workstation Licenses for Programming / Configuration.
   2. At the conclusion of project, contractor shall leave with owner a CD ROM that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

R. WEB Client
   1. BAS supplier shall provide an HTML5 based browser access to the AWS as part of standard installation. User must be able to access all displays of real-time data that are part of the AWS using a standard Web browser. Web browser shall tie into the network through owner-supplied Ethernet network connection. The AWS must be able to support 20 concurrent web client users at a minimum.
   2. Browser shall be latest version of Microsoft Edge, Firefox and Chrome. No special vendor-supplied software shall be needed on computers running browser. Data shall be displayed in real-time and update automatically without user interaction.

3. Web pages shall be automatically generated using HTML 5 from the data display files that reside on the AWS. Any system that requires use of an HTML editor for generation of Web pages shall not be considered.
4. Access through web client or thick client shall utilize the same hierarchical security scheme as the AWS. User shall be asked to log on once the client makes connection to the AWS. Once the user logs in, any and all changes that are made shall be tracked by the AWS. The user shall be able to change only those items he or she has authority to change. A user activity report shall show any and all activity of the users who have logged in to the system, regardless of whether those changes were made using a web client, thick client or through the AWS.

S. Graphic Based Displays: For each system.
1. Operator Workstation: Point data for each system. Update every 30 seconds.
2. Dynamically update data any action by user.
3. Graphic Displays: Iconic graphic representations of mechanical equipment. Display graphic files, text, trendlog, and dynamic object data displays including animation.
4. Graphic Displays: “Drill Down” capability from main display to more specific system displays or navigations tree for building equipment and system diagnostic centric display organization.
5. Tree Navigation Contents: Customizable per-user and per-group basis.
6. Systems with Terminal Unit Controls: Building floor plan with dynamic temperatures, drillable for more specific terminal information.
7. Points on graphics allow user to change field-resident Operator Workstation functions associated with project, including setpoints, weekly and exception schedules, from any screen, whether screen shows text or graphic display. Do without reference to object addresses or other numeric/mnemonic indications.
8. Protect display views unless operator credentials have proper access level. Assign access levels to each display/system object. Menu labels not to appear on graphic if operator does not have appropriate security level.
9. Analog objects: Displayed with operator modifiable units. Input objects may be displayed as graphic items on display screen as an overlay to the system graphic.
10. Information: Labeled with descriptors and shown with appropriate engineering units.
11. DDCs system must provide graphic displays and files. Systems requiring graphics development or logic programming are prohibited. Graphic Files: JPG, GIF or PNG.
12. Submit graphic displays to Owner for review and approval. Approved graphics to be in place prior to commissioning.
13. Operator Workstation: Supply graphics library, to use unaltered or modified. Include library to assemble custom graphics. System to allow creation of new graphics.
14. Data Displays: Ability to link to content outside of BAS system. Content to include, but not limited to launching external files in their native applications.

T. OmniGraphics: Graphics with custom geometry offering color gradient shading and variable opacity in scale to system variables; analog and binary, and color range settings.
1. OmniGgraphics Must Support:
   a. Displaying current values in the geometric shapes.

b. Geometric shapes to be clickable allowing another graphic display.
c. Color Scale: Support using AV's to define the color scale ranges.

2.2 CONTROL PROGRAMMING SOFTWARE

A. All DDC programming throughout the EMS network shall adhere to the following standards:
1. Programming on all controllers must be completely operator definable and modifiable and must use a single common programming language for all control devices. Use of pre-canned, factory burned-in DDC programming on controllers is not acceptable and is grounds for rejection of EMS system.
2. Programming shall be developed in an object-oriented graphical programming environment. Line by line code programming is specifically prohibited and is not acceptable.
3. Programming must accommodate all written sequences of operations.
4. Programming shall be modifiable from any server PC, operator console PC and/or portable laptop PC workstation without requiring the burning of new chips or having to directly access the local controller. Software shall accommodate the downloading of programming via established network Ethernet or modem connections.
5. Programming must support the use of virtual software points in the same manner as all physical points are supported.
6. All programming points, virtual or real, for any specific device in the entire EMS network shall be accessible to all other network devices at any given time, regardless of physical location.
7. All programming shall adhere to the BACnet protocols for Standard Command Priorities.
8. Programming software must include a pre-developed cohesive PID (proportional-integral-derivative) algorithm whereby a user can adjust gain and anti-windup coefficients accordingly to effectively accomplish advanced sequence of operation requirements.

2.3 BUILDING (GLOBAL) CONTROLLER

A. General Requirements
1. BACnet Conformance
a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
2. Building controller shall be of scalable design such that the number of trunks and protocols may be selected to fit the specific requirements of a given project.
3. The controller shall be capable of panel-mounted on DIN rail and/or mounting screws.
4. The controller shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the

object is directly monitored by the building controller module or by another controller.

5. The controller shall be capable of running up to six independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.
6. The software program implementing the DDC strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
7. Programming shall be object-oriented using control function blocks, and support DDC functions, All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
8. Programming tool shall provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
9. Controller shall have 6000 Analog Values and 6000 Binary Values
10. Controller IP configuration can be done via a direct USB connect with an operator's workstation or field computer.
11. Controller shall have at a minimum a Quad Core 996Ghz processor to ensure fast processing speeds.
12. Global control algorithms and automated control functions shall execute using a 64-bit processor.
13. Controller shall have a minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus to ensure high speed data recording, large data storage capacity and reliability.
14. Controller shall support two on-board EIA-485 ports capable of supporting various EIA-485 protocols including but not limited to BACnet MS/TP and Modbus.
15. Controller shall support two additional EIA-485 option cards, each providing two EIA-485 ports capable of supporting various EIA-485 protocols including but not limited to BACnet MS/TP and Modbus
16. Controller shall support two gigabit speed Ethernet (10/100/1000) ports.
    a. Ports are capable of supporting various Ethernet protocols including but not limited to BACnetIP, FOX, and Modbus.
17. All ports shall be capable of having protocol(s) assigned to utilize the port's physical connection
18. The controller shall have at a minimum four onboard inputs, two universal inputs and two binary inputs.
19. Schedules
    a. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
    b. Each building controller shall support a minimum of 384 BACnet Schedule Objects and 384 BACnet Calendar Objects.
20. Logging Capabilities

a. Each building controller shall log as minimum 1920 objects at 15 min intervals. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
b. Logs may be viewed both on-site or off-site using WAN or remote communication.
c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

21. Alarm Generation
a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
b. Each alarm may be dialed out as noted elsewhere.
c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
d. Controller must be able to handle up to 1920 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

22. Demand Limiting
a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 1200 loads using a minimum of two types of shed programs. Each building controller shall support up to 10 unique demand limiting program modules
b. Load shedding programs in building controller modules shall operate as defined in section 2.1.J of this specification.

23. Tenant Activity Logging
a. Tenant Activity logging shall be supported by building controller module. Each independent module shall support a minimum of 384 zones.
b. Tenant Activity logging shall function as defined in section 2.1.K of this specification.

B. BACnet MS/TP
1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps
a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum
b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. BACnet IP
1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN.
2. Must support communications using BACnet/IPv4 and/or BACnet/IPv6
3. Must support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).
4. Each controller shall support at a minimum 128 BBMD entries
5. BBMD management architecture shall support 3000 subnets at a minimum

6. Shall support BACnet Network Address Translation
7. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Expansion ports
   1. Controller shall support two expansion ports.
      a. Combining the two on-board EIA-458 ports with fully loaded expansion ports the controller shall support (6) EIA-485 trunks simultaneously
   2. Expansion cards that mate to the expansion ports shall include:
      a. Dual port EIA-485 card and EIA-232 card

E. Modbus Protocol Support:
   1. Controller shall support reading from and writing to TCP Slaves and Serial Connections (RTU or ASCI over either EIA-485 or EIA-232).
      a. Shall be capable of mapping Modbus register coil data to BACnet AV, BV, MV, AI, BI, and MI object types.
      b. Support a minimum of 6000 Mapped Modbus points.
   2. Support up to 384 virtual groupings of Modbus points where each grouping is represented as a single virtual BACnet device.
      a. Virtual BACnet devices support BACnet Change Of Value (COV) notifications
      b. Each Virtual device has diagnostic information for troubleshooting Modbus point mapping. Diagnostic point should include the following.
         1) Number of points mapped.
         2) Number of messages Transmitted and Received.
         3) Modbus Exception Counts.
         4) Display of last exception message.
         5) Serial Setting (Baud rate, Parity, Stop Bits).
   3. Integration Performance: Data age of integrated point shall be capable of 1 second for 5000 points.

F. Power Supply
   1. Input for power shall accept between 17 –30VAC, 47–63Hz.
   2. Optional rechargeable battery for shutdown of controller including storage of all data in flash memory
   3. On-board capacitor will ensure continuous operation of real-time clocks for minimum of 14 days.

G. Controller shall be in compliance with the following
   1. UL 916 for open energy management
   2. FCC Class B
   3. ROHS
   4. IEC 60703
   5. C-Tick Listed
   6. CE (EN 60730-1)

H. Controller shall operate in the following environmental conditions:
   1. -4 to 149 °F (-20 to 65 °C) without optional battery, or 32 to 122 °F (0 to 50 °C) with optional battery
   2. 0 to 95% RH, non-condensing.

2.4 ADVANCED APPLICATION CONTROLLERS

A. Provide one or more native BACnet advanced application controllers for HVAC equipment requiring DDC standalone control independent of building control module operation. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.

B. BACnet Conformance
   1. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
   2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
   3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0–10VDC, Platinum 1000 Ohm RTD, 0–5VDC, 4–20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three (3) inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs with 10-bit resolution shall support either 0–10VDC or 0–20mA. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.
   1. All outputs must have on-board Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position. The position of each and every HOA switch shall be available system wide as a BACnet object property.

D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator’s terminal.
   1. The following control blocks shall be supported:

a. Natural Log
b. Exponential
c. Log base 10
d. X to the power of Y
e. Nth square root of X
f. 5th Order Polynomial Equations
g. Astronomical Clock (sunrise/sunset calculation)
h. Time-based schedules

E. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

F. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

G. Schedules
1. The controller shall support a minimum of three (3) BACnet Schedule Objects and have a real-time clock on board with battery backup to maintain time through a power loss.

H. Logging Capabilities
1. Controller shall support a minimum of 50 trend logs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
2. Controller shall periodically upload trended data to system server for long-term archiving if desired. fsArchived data stored in (MS Jet Database or SQL) database form and shall be available for use in third-party spreadsheet or database programs.

I. Alarm Generation
1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.
2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
3. Controller must be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

J. The controller processor shall be a 64-bit processor.

K. The packaging of the controller shall provide operable doors to cover the terminals once installation is complete. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

2.5 APPLICATION SPECIFIC CONTROLLERS

A. Provide one or more native BACnet application controller for HVAC equipment requiring DDC standalone control independent of building control module operation

and for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance
   1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4, 76.8, and 115.2 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:
      a. Files Functional Group
      b. Reinitialize Functional Group
      c. Device Communications Functional Group
   2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
   3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 16-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of three (3) pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.

D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is

pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.6 AUXILIARY CONTROL DEVICES

A. Temperature Sensors
   1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with Touch Screen
   1. Hardware
      a. Room sensor shall include:
         1) Backlit touch screen LCD digital display
         2) Temperature sensor
         3) Humidity Sensor
         4) Programmable Smart Light indicator
         5) CO2 Sensor (as scheduled on prints)
      b. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F (0.2 °C) at calibration point over the range of 32-116 °F or better.
      c. Humidity sensor shall have an accuracy of +/-3% from 10-90% relative humidity or better.
      d. The intelligent room sensor's Smart Light shall have a minimum of four colors (Blue, Red, Amber and Green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of smart light shall be fully programmable.
      e. CO2 Sensor shall have an accuracy of +/- 30 ppm over the range of 0-5000 ppm or better.
      f. CO2 sensor shall utilize Automatic Baseline Correction to maintain sensor calibration without need for manual calibration.
      g. The user shall interact with the intelligent room sensor using a touch screen, with no buttons allowed.
      h. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
      i. The touch screen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
      j. Controller shall function as room control unit and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.
   2. Display Content
      a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.

b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temp to customize the view for the customer.
c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Centigrade.
d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
e. Information about the version of firmware shall be displayable on the LCD screen.
f. A cleaning mode will be provided to allow for the touch screen to be cleaned without inadvertently making changes to system parameters.
g. The intelligent room sensor shall have the ability to display the status of a lighting zone and control the on/off state of the zone from the touch screen using a tenant accessible display page.
h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g. blinds) and control the on/off state of the zone from the touch screen using a tenant accessible display page.
i. After Hours Override shall provide for the following:
    1) Override time may be set and viewed in 30-minute increments.
    2) Override time countdown shall be automatic but may be reset to zero by occupant from the sensor.
    3) Time remaining shall be displayed.
j. Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.

3. Other Modes
a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed protected with a configurable pin number.
b. Field service mode shall allow access to common parameters as dictated by the application’s sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
c. Balance mode shall, if intelligent room sensor is connected to VAV controller, allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

4. Intelligent Room Sensor shall be in compliance of the following:
a. UL Standard for Safety 916
b. FCC Part 15.107 & 109, Class B, CFR47-15
c. EMC Directive 89/336/EEC (European CE Mark)

5. Manufacturer: Alerton MicroSet 4 or approved equal

C. Sensors
1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All

programmable variables shall be available to field service tool through wall sensor port.

Manufacturer	Alerton or Approved Equal
Model	MicroTouch
Temperature Monitoring Range	32°F to 158°F
Output Signal	Changing resistance (10K □)
Accuracy at Calibration Point	+0.36°F (+/- 0.2°C)
Set Point and Display Range	N/A Blank

2. Duct Temperature:

Manufacturer	ACI or Equal
Model	TS-20XX-FB-10-AA (4”, 6”, 8”, 12”)
Calibration Adjustments	N/A
Temperature monitoring range	32°F to 158°F
Output signal	Changing resistance (10K □)
Accuracy at Calibration point	+0.36°F (+/- 0.2°C)

3. Duct Averaging Temperature:

Manufacturer	ACI or Equal
Model	TS-50XX-XD-10-AB (6’, 12’, or 24’)
Calibration Adjustments	N/A
Temperature monitoring range	32°F to 158°F
Output signal	Changing resistance (10K □)
Accuracy at Calibration point	+0.36°F (+/- 0.2°C)

4. Outside air temperature:

Manufacturer	Dwyer or Equal
Model	TE-RND-B
Calibration Adjustments	N/A
Temperature monitoring range	0°F to 150°F
Output signal	Changing resistance (10K □)
Accuracy at Calibration point	+0.4°F (+/- 0.22°C)

D. Pressure & Differential Pressure Sensors

1. Air Differential Pressure Transmitters (Low Range)
(Room Differential Pressure applications)

Manufacturer	Dwyer or Equal
Model	MS2-W111
Output	4 – 20 mA
Calibration Adjustments	Zero and span
Accuracy	+1% Full Scale
With flush-mount wall plate with screened port	A-417 or A-465 or equal
Outdoor pick port shielded to	A-306 or A-420 equal

minimize effects of wind gusts	

2. Air Differential Pressure Transmitters (Low Range)
(Filter Differential Pressure/Duct Static Pressure)

Manufacturer	Dwyer or Equal
Model	MS2-W102
Output	4 – 20 mA
Calibration Adjustments	Zero and span
Accuracy	+1% Full Scale
With pitot tip	A-302 or equal

3. Air Differential Pressure Transmitters (High Range) (Labs and for high accuracy)

Manufacturer	Setra or Equal
Model	C-264
Output	4 – 20 mA
Calibration Adjustments	Zero and spance
Accuracy	+1% Full Scale

E. Humidity Sensors:
1. Room Relative Humidity Sensor/ Temperature Transmitter:

Manufacturer	Vaisala, ACI or Equal
Model	HMW80 Series/ A/RH3-R
Output signal	4-20mA
Accuracy	+/- 3%
Measurement Range Humidity	0 to 100% RH
Measurement Range Temperature	23°F to 131°F /35 to 122°F

2. Duct Relative Humidity Sensor/Transmitter:

Manufacturer	Vaisala, ACI or Equal
Model	HMD80 Series / A/RH3-D
Output signal	4-20mA
Accuracy	+/- 3%
Measurement Range Humidity	0 to 100% RH
Measurement Range Temperature	23 to 131°F / -40 to 140°F

F. Switches and Status Indicators
1. Differential Pressure Switch
   a. Diaphragm with adjustable setpoint and adjustable differential.
   b. Snap-acting Form C contacts rated for the application.
   c. For water, switch must tolerate differential pressure up to 60 PSI.
   d. For air, provide with manufacturer’s recommended static pressure sensing tips.
   e. Provide with status indicator point to BAS.
2. Current Switch
   a. Solid-core or split-core
   b. Range as required by application

c. Adjustable trip point
d. Switch:
    1) Solid state
    2) Normally open
    3) Relay output: minimum 120 VAC or VDC, 0.3 Amps.
    4) Zero off state leakage
e. Low Frequency Limit: 6 Hz
f. LED trip indicator
g. UL and CSA approved
h. May be used to start other devices if so indicated on Building Automation Drawings.
i. Manufacturers Veris Industries or Equal

3. Occupancy Sensor
    a. Ceiling mount passive infrared occupancy sensor
    b. Sensor shall be mounted as indicated on the approved drawings.
    c. Sensor output shall be accessible by EMS or HVAC system.
    d. Time delay adjustment from 30 seconds to 30 minutes.
    e. Operates at 24 VAC or 24 VDC +/-10%
    f. UL and cUL Listed
    g. EnOcean wireless or hardwired are acceptable.

2.7 ELECTRONIC ACTUATORS

A. Quality Assurance for Actuators and Valves
    1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
    2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
    3. Five-year manufacturer’s warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves
    1. VAV box damper and reheat valve actuation shall be floating type or analog (2–10 VDC, 4–20 mA).
    2. Fan Coil Unit, Radiators and other terminal devices may be floating type or analog (2-10 VDC, 4-20 mA).
    3. Modulating Valve and Actuator control on Air Handling Units shall be analog (2–10 VDC, 4–20 mA).

C. Actuators for damper and control valves 0.5–6 inches shall be electric unless otherwise specified, provide actuators as follows:
    1. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify actuators.
    2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.
    3. Five-year manufacturer’s warranty. Two-year unconditional and three-year product defect from date of installation.
    4. Fail safe shall be provided when specified. Capacitors or spring return.
    5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.

6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
7. A pushbutton gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24 VAC and consume 10 VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators
1. Air Handler Economizer actuators shall utilize analog control 2–10 VDC; floating control is not acceptable.
2. Electric damper actuators (including VAV box actuators) shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
3. Size actuators for sufficient torque for damper area. Small outside air and return air economizer damper sections may be mechanically linked together if one (1) actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.

2.8 DAMPERS

A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow.
1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
b. Other modulating dampers shall be opposed-blade.
c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (⅛ in.) extruded aluminum with reinforced corner bracing.
3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m2 (10 cfm per ft2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
6. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
7. Modulating dampers shall provide a linear flow characteristic where possible.
8. Linkages. Dampers shall have exposed linkages.

2.9 ENCLOSURES

A. All controllers, power supplies and relays shall be mounted in enclosures.

B. Interior enclosures shall be NEMA1, exterior enclosures shall be NEMA3R.
C. Enclosures shall have hinged, locking doors.
D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.
E. All temperature control panels shall be fabricated in a UL-listed panel shop. Field assembled temperature control panels are not allowed.

2.10 POWER SUPPLIES AND CONTROL TRANSFORMERS

A. Basis of design PSH500 from functional devices.
B. Provide 120V plug receptacle in all panels with terminal unit routers.
C. Control transformers and power supplies shall be UL-Listed.
D. Provide Class 2 current-limiting type or over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements.
    1. Transformer shall be properly sized for application. Limit connected loads to 80% of rated capacity.
    2. Line voltage units shall be UL Recognized and CSA Approved.
E. DC Power Supplies: DC power supply output shall match output current and voltage requirements. Power supply shall be full-wave rectified type with the following minimum Specifications:
    1. Built-in overvoltage and overcurrent protection and able to withstand a 150% current overload for a minimum of three (3) seconds without tripping or failure.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this section may properly commence.
B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 GENERAL

A. Install all line voltage wiring, concealed or exposed, in accordance with Division 26.
B. All concealed control and low voltage wiring (above ceilings and in walls) may be installed in plenum rated cable.
C. Supply/Install all necessary transformers/power supplies as required to power BAS instrumentation.
D. DDC Contractor shall coordinate with other trades as required by Section 23 09 23. This shall include submitting documentation and coordination plans as described in that Section.
E. DDC Contractor shall protect all products and retain them in manufacturer packaging until installed, as required by Section 23 09 23.
F. DDC Contractor shall perform all Work under this Section in accordance with the manufacturer's instructions and the general workmanship requirements specified in Section 23 09 23 and in Division 23. DDC Contractor shall in addition observe the following requirements:

1. All sensors and products shall be mounted rigidly and adequately supported.
2. Wires attached to sensors shall be sealed against bulk air movement in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
3. Sensors which provide data used to maintain a setpoint with variable-speed equipment (e.g. duct pressure sensor used for fan speed control, or end-of-loop differential pressure used for pump speed control) shall be hardwired directly to the same controller that controls the variable-speed equipment, which shall also be the controller where the variable speed control loop resides.

G. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum three (3) feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
H. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
I. Ethernet and Fiber network requirements are to be governed by Division 26 and Division 27 requirements.
J. Underground conduit and wiring are only required where meters or alarm devices are necessarily located underground. Such wiring to be governed by associate spec sections and provided by respective trades.
K. The selection and installation of line-voltage power wiring and wiring connections, including subpanels, conduit and raceways, required for Work in this Section shall be provided by the Division 26 contractor based on control panel locations pre-coordinated with the DDC Contractor.
L. The selection and installation of low-voltage power wiring and wiring connections, including subpanels, conduit and raceways, required for Work in this Section shall be provided by the DDC Contractor.
M. Where wiring specifications differ between Division 23 09 23 and other divisions, Division 23 09 23 shall take precedence when pertaining to Control, Communication, 24V wiring and associated conduit. This includes all IO, comm, and serial networks.
N. The requirements of this section shall not supersede local or national codes.

3.3 POWER WIRING INSTALLATION

A. Division 26 electrical contractor shall provide 120 volt, 20 amp circuits and circuit breakers from normal and/or emergency power panel for direct digital control systems.
B. Division 23 09 23 contractor to provide documentation with panel locations and load requirements to Division 26.
C. All 120V to BMS panels provided by division 26. General requirements for obtaining power include the following:
    1. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it.
    2. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120V source fed from a common origin.
    3. Where control devices are located in or on new equipment, coordinate with the equipment manufacturer and feed the control with the same source as the

equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or not of the correct voltage to supply the controls, provide separate transformer(s).

4. Unless transformers are provided with equipment, DDC Contractor shall provide transformers for all low voltage control devices including terminal units. Transformer(s) shall be located in control panels in readily accessible locations.

D. Emergency, Uninterruptible, and Backup Power
   1. UPS and Emergency power is not the responsibility of the DDC contractor unless otherwise indicated for a specific piece of equipment.
   2. Said power to be design and implemented in full by Division 26 engineer/contractor.

E. Work shall comply with NEC with all state and local amendments, and all requirements of Division 26 Specification for power wiring.

3.4 CONTROL AND COMMUNICATION WIRING INSTALLATION

A. General
   1. Terminate all control and/or interlock wiring.
   2. Install wiring in raceway or conduit when located in unconcealed or inaccessible locations, locations subject to foot traffic in the normal course of building operations, locations where wires may be damaged including equipment rooms within 8 feet of floor, or as required by code or AHJ.
   3. EMT conduit shall be used in the following applications:
      a. Garage
      b. Central plant
      c. Cooling towers
      d. AHU mechanical rooms
      e. Vertical façade dampers, where cable is not concealed in window facia plate.
      f. Outdoor locations
      g. Electrical Rooms.
      h. Where exposed to damage.
   4. Rigid conduit is not necessary unless required by AHJ.
   5. Low voltage control signal and IO wiring may be installed without conduit or raceway in concealed, protected, and accessible locations such as above suspended ceiling, in underfloor spaces or spaces requiring a ladder or lift to access.
      a. Suspended/supported plenum rated cable in above T-bar ceilings and in underfloor areas must be installed as follows:
         1) With ties or slip rings bundling runs or groupings of wiring at 8 ft intervals (+/- 1 ft).
         2) With ties or slip rings securing all wiring to duct or floor supports at 90-degree path runs.
         3) Laying wiring on the ground is acceptable so long as it is also cable or attached with slip rings to floor supports.
         4) This wiring is a permanent feature of the building and should not be mixed in with data cabling. Using the same cable trays as Division 27 or any other computer network cabling is not acceptable.

6. Tacking wire to top of duct with magnetic bridal rings is acceptable. Drilling zip ties fasteners into duct for securing wiring is not acceptable. Cable tying or using slip rings attaching wiring to duct supports is acceptable.
    a. Thermostat wiring does not require conduit in walls.
7. In mechanical/electrical rooms EMT conduit is the only acceptable routing type for DDC wiring.
8. Above hard lid ceilings with over a 30’ span between access hatches EMT is the only acceptable routing type for DDC wiring.
9. Flex conduit in lengths of 6ft or less for sensors in lieu or in conjunction with EMT conduit is acceptable.
10. EMT for DDC systems can (and where feasible should) follow the ducts or pipes it serves. Sharing supports with this equipment is acceptable.
11. Seismic ratings of equipment cannot be compromised. DDC contractor to use discretion where conflicts could arise, seismic takes precedence.
12. Clad or Jacketed Cable is not in conformance with the owners wiring standards and therefore not an acceptable substitute for EMT conduit.
13. Do not install communication or signal wiring in raceway or enclosures containing high- or low-voltage power wiring.
14. Junction boxes may be used for terminal blocks to join sections of wire where long pulls or pulls with many bends are necessary.
15. Up to 4 bends and 150ft are allowable between wire pull sections.
16. Run direct current signal wires separately from alternating current conductors. Where allowed by code, AC and DC wiring routes shall only cross at a 90-degree angle.
17. All temperature sensors on external walls shall have sealed handy boxes and foam backing plates to insulate the temperature sensor from drafts in the wall.

B. All wiring shall be installed in a neat and workmanlike manner.
C. Follow all manufacturers’ installation recommendations.
D. Wiring not in conduit shall be installed as follows:
    1. Routed parallel or perpendicular to building and/or mechanical lines.
    2. Supported by or anchored as follows. Do not lay wiring on the ceiling.
    3. Wire that is not used for Ethernet, TCP/IP, or BACnet IP networking may be secured to structural members or to supports for ductwork, piping, and raceways.
    4. Wire that is used for Ethernet, TCP/IP, or BACnet IP networking (i.e. “category” cable) shall be supported from below by J-hooks, trays, or similar means. Do not kink or twist category cabling, and do not zip-tie it to its supports.
    5. Installed in sleeves where it passes through walls and floors. Maintain fire, smoke, envelope and pressure ratings of each space.
    6. All wire and cable installed in ceiling return plenums must be rated for plenum installation. If uncertain, contractor shall assume that above-ceiling spaces are plenums.
    7. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
    8. All wire-to-device connections shall be made at a terminal block or terminal strip.
    9. All wire to wire connections for power shall be at a terminal block. Communication wire shall be continuous, with no wire-to-wire connections.

10. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

E. Shielding
   1. Maintain continuous shielding of all communications and signal wiring.
   2. Shields shall be grounded only at controller or power source end and floated at other end, unless otherwise recommended by the controller manufacturer.
   3. Float shields through termination points, maintaining only on single grounding point and insulating from ground at all other points.

F. Identification
   1. Use color-coded conductors consistently throughout the entire DDC System installation.
   2. All field wiring shall be properly labeled at each end.

G. The DDC Contractor shall verify integrity of all wiring to ensure continuity and freedom from shorts and grounds after the installation is complete.

H. All field wiring shall be properly labeled at each end for the following:
   1. All central plant IO and comm
   2. All AHU IO and comm
   3. All terminal unit comm (no IO)
   4. .

3.5 AIR SENSORS AND DEVICES

A. Temperature Sensors
   1. Single Point Duct Sensors
      a. Install probe at approximate midpoint of duct height.
      b. Install such that probe penetrates minimum 20% of duct width, to avoid boundary layer.
      c. If installing near a coil:
         1) Upstream of coil, install a minimum of 6 inches from coil.
         2) Downstream of coil, install a minimum of 12 inches from coil if possible, 6 inches absolute minimum.
         3) No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements.
   2. Averaging Duct Sensors
      a. Install sensor in serpentine manner with a minimum of four vertical passes (“M” pattern), covering full width and height of duct.
      b. Support at each bend with capillary clip.
      c. Where located in front of filers (e.g. mixed air temperature sensor), maintain access for filter removal.
      d. Provide minimum one sensor per AHU module. A single sensor shall not span coil segments. Wire sensors to provide leaving air temperature reading on a per-coil basis.
      e. If installing near a coil:
         1) Upstream of coil, install a minimum of 6 inches from coil.
         2) Downstream of coil, install a minimum of 12 inches from coil if possible, 6 inches absolute minimum.
         3) No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements.

3. Outdoor Air Sensors
   a. Install sensor in aspirating enclosure.
   b. Installation location shown on Contract Drawings is approximate.
   c. DDC Contractor is responsible for selecting actual installation location to provide accurate readings without distortion from solar or building influences.
      1) Good locations are shielded from the sun and away from reflective surfaces, air intakes and exhausts, and heat producing equipment.
      2) Poor locations include above sun-exposed walls, near windows, doors and exhaust vents, under eaves, or near equipment.
      3) If no good location is available, notify Engineer of Record.
4. Room Sensors and Thermostats
   a. Room sensors and thermostats shall be installed on concealed junction boxes properly supported by wall framing.
   b. Install all devices with insulated base.
   c. For sensors mounted in exterior walls, seal all junction box openings with mastic sealant and pack junction box with insulation.
   d. For sensors on exposed unfurred columns, use Wiremold or equal raceway that is smallest required to enclose wiring and Wiremold or equal junction boxes that are narrowest required to enclose sensor and wiring connections. Color shall be per the architect; submit for approval prior to installation.
   e. Install sensors in locations as shown on Contract Drawing mechanical floorplans. If installation in indicated location is not feasible, notify the Engineer of Record.
   f. Unless otherwise noted on Contract Drawings, wall-mounted sensors shall be installed at same centerline elevation as adjacent electrical switches, 4 feet above the finished floor where there are no adjacent electrical switches, and within ADA limitations.
   g. Wall mounted CO2 sensors shall in all cases be installed between three and six feet above finished floor, to comply with code requirements.

3.6 SWITCHES AND STATUS INDICATORS

A. Current Switch
   1. Adjust current setpoint (i.e. ON/OFF signal threshold) as follows:
      a. For fan status, with discharge damper: Adjust so that fan status is OFF when fan discharge damper is fully closed while fan is running.
      b. For fan status, with belt-driven fan: Adjust so that fan status is OFF when fan belt is broken and motor is running.
      c. For pump status: Adjust so that pump status is OFF when pump is running with shutoff valves closed (i.e. pump is dead-headed).

3.7 DDC CONTROLLER INSTALLATION

A. Physical Installation
   1. Central System Controllers and associated devices shall be assembled into panels or enclosures by DDC Contractor in a workshop environment.

2. Unitary Controllers (VAV Box, FCU, etc) may be direct mounted on equipment with no enclosure.
3. Install controllers in appropriately rated enclosures as required by field conditions and this Section.
4. Install all controllers in readily accessible location.
5. For every Central System Controller, provide a dedicated power switch if the controller does not include one built in.
6. Connect controllers to a power source of equal reliability (normal, emergency, uninterruptable, etc.) to the power source of the equipment being controlled.
7. HVAC systems and equipment served by a backup power source or UPS shall have associated DDC system products that control such systems and equipment also served from a backup power source or UPS.
8. Connect sensors, actuators and other attachments such that they can be quickly and easily disconnected for service. All wiring connections shall be made to field-removable, modular terminal strips.

B. Functional Installation
   1. Configure DDC System to share data between networked controllers and other network devices.
      a. Point information from any controller (including BCs, AACs, and ASCs) and from any gateway shall be capable of being used in a control sequence in any other panel.
      b. The use of a computer or another DDC device as a communications server between control panels and/or gateways is not acceptable.
   2. Each individual mechanical system or piece of equipment shall be controlled by no more than one controller with sufficient capacity to be connected to all field devices and sensors associated with that system and/or piece of equipment.
      a. All points associated with and common to one unit or other complete system or equipment shall reside within a single controller (including I/O expander boards as allowed below). Point data which may be transmitted over the LAN are limited to the following exceptions:
         1) Global points such as outdoor air temperature, building pressure.
         2) Requests sent from zones to systems or systems to plant, used to trigger equipment operation or reset setpoints.
         3) Mode information sent from zones to systems or systems to plant used to select or change operating logic.
         4) Notwithstanding these exceptions, all operations required to maintain a controlled variable at setpoint must still be performed entirely within a single controller.
   3. Configure controllers for automatic safe restart after a loss of power:
      a. If programming is intact, the controller shall resume full operation without operator intervention. All monitored functions shall be updated.
      b. If battery backup has been exhausted or programming is lost for any reason, the controller shall automatically report this condition and prepare to receive a download over the network.
      c. The controller shall automatically reset its clock such that time dependent functions occur on schedule without a manual reset.

d. The DDC Contractor shall pre-configure staggered start such that the startup surge or inrush current of each major piece of equipment (air handling unit, boiler plant, chiller plant, etc.) has time to resolve before the next start event.

3.8 TESTING AND COMMISSIONING

A. General
1. Perform tasks in the order outlined subject to direction of the General Contractor.
2. Notify the Owner Representative and the Engineer if jobsite circumstances, Project schedule, or General Contractor instructions require substantial deviation from this sequence of events.
3. DDC Contractor shall provide a qualified technician who shall execute all Functional Tests in the presence of the Owner Representative and the Engineer of Record.
4. All deficiencies identified shall be corrected and demonstrated to the Owner Representative after resolution for acceptance.

B. Test Forms
1. Point-to-Point Test Forms
2. Provide forms for all checks and tests
3. Point-to-Point (Pre-Functional) and Functional Test procedures and associated forms shall be prepared by owner representative or commissioning agent.
4. If there is no owner representative then DDC Contractor shall prepare forms to verify correct execution of Sequences of Operations logic and correct operation of all alarms, interlocks, and schedules without compromising system integrity or damaging any piece of equipment.
5. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
6. All forms shall be provided in digital format.
7. Test and Balance forms shall be provided by Test and Balance (TAB) Contractor.

C. Point-to-Point Tests
1. Inspect the installation of all devices. Review the manufacturer’s installation instructions and validate that the device is installed in accordance with them.
2. Ensure devices are properly installed with adequate clearance for maintenance.
3. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in raceway.
4. Verify that all sensor locations are as indicated on drawings and are away from heat sources and other causes of erratic operation.
5. For each controller, perform Point Verifications and Point-to-Point Tests
   a. Binary Outputs:
      1) Verify proper installation
      2) Verify correct normal position
      3) Verify correct response to command including parity of response (i.e. verify that a command OFF turns equipment off and not on).
   b. Binary Inputs:
      1) Verify proper installation
      2) Verify signal from device maps to correct signal at graphical interface.
      3) Verify input signal thresholds are correct
   c. Analog Outputs

1) Verify proper installation
2) Verify correct normal position.
   (a) Test all fail-safe actuators by disconnecting power and verifying direction of travel.
3) Verify correct response to command including direction of movement.
4) Verify correct start and span (maximum and minimum stroke)
   (a) Verify that all automatic valves and dampers close completely upon a closed command. Adjust valve stem and damper blade travel as required.
   (b) Verify/adjust output range for points sending commands (e.g. setpoint) to other equipment.

d. Analog Inputs
   1) Verify installation of sensors.
   2) Verify correct signal and mapping at graphical interface.
   3) Calibrate sensors that require field calibration, if any, as note on points list on Building Automation drawings or specifically listed elsewhere in this specification section.
      (a) Adjust calibrating parameters in software (such as slope and intercept) as required.
      (b) A calibration log shall be kept and initialed by the technician indicating date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.
      (c) Inaccurate sensors must be replaced if calibration is not possible.

6. User Interface Checks
   a. All user interface elements and graphics are functional.
   b. Graphics are properly bound to physical devices or virtual points.
   c. Links and page jumps are functional and logical.
   d. Events and alarms are annunciated timely
7. Point-to-Point Test Report
   a. Document results on forms and submit for approval as Point-to-Point Test report.
   b. Point-to-point tests must be performed and documented for every individual point in the system. Testing a sample or subset of points shall not be acceptable. The Point-to-Point report shall not be accepted, nor shall further work be authorized, until all point-to-point tests have been completed to the satisfaction of the Engineer of Record and Owners Representative.

D. Test and Balance
   1. Coordinate with Work performed under Division 23 Test and Balance (TAB). DDC Contractor shall support TAB Contractor in execution of tests that require interaction with or overrides of the DDC System.
   2. Provide informal training of (1) hour to TAB contractor foreman and subordinate with the purpose of allowing them to navigate and adjust all hardware and software necessary to perform their scope autonomously.
   3. Software shall be provided to TAB Contractor free of charge on a temporary basis to allow calibration of non-zone equipment controls and other Work specified under Division 23 TAB.

4. All zone equipment TAB Contractor shall use T-Stat for balancing.

E. Functional Tests
   1. Functional Tests shall test all control logic in a formal manner to verify that Sequences of Operation were programmed accurately and provide the intended system behavior. Owner representative and Engineer of Record will witness these tests.
   2. Each functional test shall consist of a series of defined steps.
      a. For each step, test form shall include descriptions of an action/override to initiate the step and the expected system response.
      b. For each step, technician performing test shall record actual system response and any notes or comments.
      c. Expected response and actual response shall be described qualitatively (e.g. “fan speed increases”) or quantitatively (e.g. “setpoint increases by 1.5°F”) as appropriate.
      d. Technician shall describe all observed responses. Where quantitative results are expected, technician shall record specific values observed.
   3. Testing schedule shall be coordinated with Owner’s Representative, commissioning agent and Engineer of Record.
   4. All accepted Functional Tests shall be conducted by the DDC Contractor with results confirmed and signed by the Contractor’s technician.
   5. Functional Test Report
      a. After submitted test forms and trends have been accepted, DDC Contractor shall perform all listed tests, take corrective action as required for failed tests, and repeat tests until a passing condition is obtained.
      b. Document results on forms and submit digitally for approval as Functional Test report.

F. Remedial Work
   1. Failed demonstration tests will require any remedial work at no additional cost to owner.
   2. It is possible that deficiencies in the trades of others can be uncovered through course of Division 23 functional testing. Such deficiencies to be corrected at the expense of the associated trade and compensation for troubleshooting, diagnosing and retesting on the part of the DDC contractor to be back charged to the offending trade.

3.9 TRAINING

A. Include 16 hours total of on-site training to assist personnel in becoming familiar with site-specific issues, systems, Sequences of Operations, etc.

B. Training Schedule
   1. Schedule training to provide Owner with at least 10 business days advance notice.
   2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays.
   3. Training shall be on site.

C. Attendance Tracking
   1. Circulate sign-in sheet at beginning of each session and solicit attendees to sign/initial.

D. Off-Site Primary/Factory System Training
   1. Factory training is not required.
E. Regular Operators shall be trained to perform the following tasks:
   1. Understand control system architecture and configuration
   2. BMS Control system components
   3. Understand system operation and Sequences of Operations
   4. Operate the workstation and peripherals
   5. Log on and off the system
   6. Access graphics, point reports, and logs
   7. Adjust and change system set points, time schedules, and holiday schedules
   8. Understand and acknowledge alarms
   9. Understand system drawings, and Operation and Maintenance manual
   10. Understand the Project layout and location of control components
   11. Print reports
   12. Export trends
F. Training Materials
   1. Present 1 hard copy of the approved submittals and as-builts as described above.
   2. Provide each attendee with a color hard copy of all training materials and visual presentations.
   3. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
   4. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping.
B. Valves.
C. Flexible connections.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 07 19 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

A. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers 2013 (Reapproved 2014).
B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2019, with All Amendments and Errata.
C. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2021.
D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2022.
F. ASME B31.9 - Building Services Piping 2020.
G. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service 2020.
H. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.
I. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.
K. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
L. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. See Section 01300 - Submittals, for submittal procedures.
C. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturer's catalog data including load capacity.

D. Design Data: Submit design data indicating pipe sizing. Indicate load-carrying capacity of trapeze, multiple pipe, and riser support hangers.
E. Test Reports: Indicate results of leak test, acid test.
F. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.
B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
C. Valves:
    1. Use service valves on suction and discharge of compressors.
D. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

2.2 REGULATORY REQUIREMENTS

A. Comply with ASME B31.9 for installation of piping system.
B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
C. Welders Certification: In accordance with ASME BPVC-IX.
D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.3 PIPING

A. Copper Tube: ASTM B 280, H58 hard drawn, sealed ends.
    1. Fittings: ASME B16.22 wrought copper.
    2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
B. Pipe Supports and Anchors:
    1. Conform to ASME B31.5.
    2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Vertical Support: Steel riser clamp.
7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
10. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 VALVES

A. Manufacturers:
   1. Hansen Technologies Corporation: www.hantech.com/#sle.
   2. Henry Technologies: www.henrytech.com/#sle.
   3. Flomatic Valves: www.flomatic.com/#sle.
B. Service Valves:
   1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

2.5 FLEXIBLE CONNECTORS

A. Manufacturers:
   1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk/#sle.
   2. Flexicraft Industries: www.flexicraft.com/#sle.
   3. Penflex: www.penflex.com/#sle.
B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain-end ferrous pipe.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.
B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
C. Install piping to conserve building space and avoid interference with use of space.
D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
F. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.5.
   2. Steel hanger rods and clevis shall be cadmium or zinc plated.
   3. Support horizontal piping as indicated.
   4. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   5. Place hangers within 12 inches of each horizontal elbow.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.
G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
H. Provide clearance for installation of insulation and access to valves and fittings.
I. Provide access to concealed valves and fittings.
J. Flood piping system with nitrogen when brazing.
K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
L. Insulate piping.
M. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
N. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
O. Fully charge completed system with refrigerant after testing.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

3.4 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ducts.
B. Flexible ducts.
C. Air plenums and casings.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 230713 - Duct Insulation.
C. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCE STANDARDS

A. ASHRAE Std 126 - Method of Testing HVAC Air Ducts 2020.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
E. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
F. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems 2020.
G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
I. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids 2020.
J. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
K. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
L. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines 2001.
M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.
O. UL 1978 - Grease Ducts Current Edition, Including All Revisions.

P. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies Current Edition, Including All Revisions.

1.4 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.

1.5 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide data for duct materials.
C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all ductwork systems. Provide 1/4"=1'-0" ductwork layout plans showing duct routing, offsets, fittings, duct accessories, fire/smoke dampers, hydronic piping, seismic bracing, etc. Shop drawings shall by fully coordinated with all other trades, including the building structure, finishes, fire sprinkler piping, plumbing piping, hydronic piping and electrical systems.
D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.7 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A, NFPA 90B, and SMACNA (DCS) guidelines unless stated otherwise.
B. Ductwork to be galvanized steel unless otherwise indicated.
C. Duct Sealing and Leakage in accordance with Static Pressure Class:
    1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:

a. Supply Air: 2 in-wc pressure class, galvanized steel.
b. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
c. Return and Relief Air: 1 in-wc 2 in-wc pressure class, galvanized steel.
d. General Exhaust Air: 1/2 in-wc pressure class, galvanized steel.

2. Low Pressure Service: Up to 2 in-wc:
   a. Seal: Class C, apply to seal off transverse joints.
3. Low Pressure Service: From 2 in-wc to 3 in-wc:
   a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
4. Medium and High Pressure Service: Above 3 in-wc:
   a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.

D. Duct Fabrication Requirements:
   1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
   2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
   3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
   4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
   5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
   6. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.
   7. Exposed ductwork within occupied spaces shall be 20 gauge minimum.

2.2 METAL DUCTS

A. Material Requirements:
   1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Round Spiral Duct:
   1. Round spiral lock seam duct with galvanized steel outer wall.
   2. Manufacturers:
      a. EHG, a DMI Company: www.ehgduct.com/#sle.
      b. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
      c. Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
      d. MKT Metal Manufacturing: www.mktduct.com/#sle.

C. Connectors, Fittings, Sealants, and Miscellaneous:
   1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
   2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
      a. Manufacturers:
         1) Carlisle HVAC Products: www.carlislehvac.com/#sle.

2) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
3) Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.

3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   b. VOC Content: Not more than 250 g/L, excluding water.
   c. Sealants intended for use outdoors to include UV inhibitors.
   d. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
   e. Manufacturers:
      1) Carlisle HVAC Products; Hardcast Duct-Seal 321 Indoor/Outdoor Water Based Duct Sealant: www.carlislehvac.com/#sle.
      2) Design Polymerics; DP 1010 Water Based Smooth Duct Sealant, Premium Quality: www.designpoly.com/#sle.
      3) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
4. Gasket Tape:
   a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
   b. Manufacturers:
      1) Design Polymerics; DP 1040 100 Percent Solids, High Pressure/High-Velocity Butyl Gasket Tape: www.designpoly.com/#sle.
      2) Elgen Manufacturing Company, Inc; 440 Butyl Gasket Tape: www.elgenmfg.com/#sle.

2.3 FLEXIBLE DUCTS

A. Flexible Air Ducts:
   1. UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound spring steel wire.
   2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   3. Pressure Rating: From 4 in-wc positive to 0.5 in-wc negative.
   4. Maximum Velocity: 4,000 fpm.
   5. Temperature Range: Minus 20 to 210 degrees F.
   6. Manufacturers:
      a. JP Lamborn Co: www.jplflex.com/#sle.
      b. Atco Rubber Products, Inc..

2.4 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.
B. Minimum Fabrication Requirements:
   1. Fabricate acoustic plenum or casing with reinforcing turned inward.
   2. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.

3. Construct panels 1 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.

C. Access Doors:
1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).
B. Install products following the manufacturer's instructions.
C. Comply with safety standards NFPA 90A and NFPA 90B.
D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
F. Ductwork exposed to view outdoors shall be primed and painted, color by architect.
G. Flexible Ducts: Connect to metal ducts with adhesive plus sheet metal screws.
H. Flexible Ducts: Maximum length of single runout to air inlet or outlet to be 5 feet per CMC.
I. Duct sizes indicated are outside dimensions. For lined ducts, duct sizes must be increased to account for lining.
J. Seal all standing seams and transverse joints in all sheetmetal ductwork with Hardcast DT tape, 4 inches wide, and Hardcast FTA-20 adhesive.
K. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
L. Use double nuts and lock washers on threaded rod supports.
M. Connect diffusers boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
N. Use stainless steel for ductwork exposed to view in Kitchen areas.
O. Kitchen hood exhaust ductwork shall so be constructed and installed that grease cannot be pocketed in any portion thereof, and the system shall slope not less than 1/4 unit vertical in 12 units horizontal (2% slope) toward the hood or toward an approved grease reservoir.
P. Kitchen hood exhaust ductwork shall be wrapped with a 2 hour fire resistive duct wrap designed for use specifically with kitchen grease ducts, installed in accordance with manufacturer's installation instructions.
Q. Grease ductwork systems shall be leakage tested per CMC 510.5.3.1 and CMC 510.5.6. Perform light test: A light of no less than 100 watts is passed through the entire duct system, including the hood-to-duct connection. If any light shines through any portion of the ductwork in a darkened room, the hole must be found and welded so that the light is no longer visible.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices.
B. Duct access doors.
C. Duct test holes.
D. Flexible duct connectors.
E. Volume control dampers.
F. Miscellaneous products:
    1. Damper operators.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 31 00 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
F. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.
G. UL 1978 - Grease Ducts Current Edition, Including All Revisions.

1.4 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.
D. Section 013300 - Submittals.

1.5 SUBMITTALS

A. See Division 1 specifications for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations of access doors and test holes.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES

A. Manufacturers:
   1. ProRail, Ductmate Industries, Inc.
   2. Duro Dyne Corp.
B. Manufactured turning vanes with 2" single thickness curved blades set at 1-1/2" on-center mounted in 2" vane rails, self-aligning, hot dipped galvanized steel.
C. Turning vanes, vane rails and mounting shall be constructed and installed in accordance with the SMACNA "HVAC Duct Construction Standards".

2.2 DUCT ACCESS DOORS

A. Manufacturers:
   1. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. or equal.
B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum 1-inch thick insulation with sheet metal cover.
   1. High Temperature Duct Access Doors:
      a. Comply with NFPA 96.
      b. Comply with UL 1978.
C. Access doors with sheet metal screw fasteners are not acceptable.

2.3 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.4 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:
   1. Carlisle HVAC Products: www.carlislehvac.com/#sle.

2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections (Indoors): Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.
   2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

D. Flexible Duct Connections (Outdoors): Fabric crimped into metal edging strip.
   1. Fabric: Ventfabrics Ventlon UL listed fire-retardant duPont's Hypalon coated woven glass fiber fabric to NFPA 90A, minimum density 26 oz per sq yd, sunlight, ozone and weather resistant.
      a. Net Fabric Width: Approximately 3 inches wide.
   2. Metal: 3 inches wide, 24 gage thick galvanized steel.

2.5 VOLUME CONTROL DAMPERS

A. Manufacturers:
   1. Nailor Industries, Inc: www.nailor.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. United Enertech: www.unitedenertech.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Single Blade Dampers for Round Ductwork and Rectangular Ductwork up to 10 inches in Height: 18 gauge steel minimum.

D. Multi-Blade Damper for Rectangular Ductwork: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware; Model CD35 Manufactured by Ruskin. Provide Ruskin Model CD50 for installation in medium pressure ductwork and/or ducts with velocities exceeding 1500 FPM.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings, Ventlok Model 607. On multiple blade dampers, provide oil impregnated nylon or sintered bronze bearings.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.6 MISCELLANEOUS PRODUCTS

A. Remote Balancing Damper Operator: Cable operated remote damper controller.
   1. Manufacturers:
      a. Young Regulator Co.; www.youngregulator.com
   2. "Bowden" damper regulator with mounting bracket, hub and cable coupling.
   3. "Bowden" stainless steel operating cable and control wrench. Cable to be 50 foot length standard.
   4. Recessed control box with control shaft, cable coupling and cover plate.
   5. Provide options and accessories as needed for balancing damper.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 31 00 for duct construction and pressure class.
B. Coordinate fire/smoke damper requirements with Division 26 and Division 28.
C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 14 by 14 inch size access door for hand and shoulder access, or as indicated on drawings.
D. For concealed balancing dampers only where damper is inaccessible, provide Young Regulator "Bowden" cable operated damper controller.
E. Provide duct test holes where indicated and required for testing and balancing purposes.
F. Provide balancing dampers at points on supply, return, outside air and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof exhausters.
B. Ceiling exhaust fans.
C. Inline centrifugal fans and blowers.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

1.3 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
B. AMCA 99 - Standards Handbook 2016.
C. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.
D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
E. AMCA 211 - Certified Ratings Program Product Rating Manual for Fan Air Performance 2022.
F. AMCA 260 - Laboratory Methods of Testing Induced Flow Fans for Rating 2020.
G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2022.
I. AMCA 311 - Certified Ratings Program Product Rating Manual for Fan Sound Performance 2016.
J. ANSI Z9.5 - Laboratory Ventilation 2022.
K. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids 2020.
L. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
M. UL 705 - Power Ventilators Current Edition, Including All Revisions.
N. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances Current Edition, Including All Revisions.

1.4 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.

B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.
D. Section 013300 - Submittals.

1.5 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
C. Manufacturer's Instructions: Indicate installation instructions.
D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Protect units from physical damage by storing indoors or off site until roof mounting curbs or other mountings are in place, ready for immediate installation of units.

1.8 WARRANTY

A. See Section 01700 - Contract Closeout, for additional warranty requirements.
B. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Greenheck Fan Corporation: www.greenheck.com/#sle.
B. Loren Cook Company: www.lorencook.com/#sle.

2.2 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.
B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
D. Fabrication: Comply with AMCA 99.
E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.
F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.3 ROOF EXHAUSTERS

A. Product Requirements:
   1. Performance Ratings: Conform to AMCA 210 and bearing the AMCA Certified Rating Seal.
   2. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.
   3. Fabrication: Conform to AMCA 99.
   4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

C. Roof exhaust fans fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.

D. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance.

E. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment.

F. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.

G. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

H. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

I. Roof Curb: 12 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, and insulation.

J. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.

K. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

L. See drawing schedule for additional optional equipment requirements.

2.4 **CEILING EXHAUST FANS**

A. The fan wheel shall be of the galvanized steel, forward curved, centrifugal type. Wheels shall be dynamically and statically balanced.

B. Motors shall be of the heavy duty type with permanently sealed ball bearings. The wheel shaft shall be ground and polished steel mounted in permanently sealed pillow block bearings. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the machined cast iron type, keyed and securely

attached to the wheel and motor shafts. The motor pulleys shall be adjustable for final system balancing.

C. All fans shall bear the AMCA Certified Ratings Seal for air performance.
D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
E. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing , resilient mounted motor.
F. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor and wall mounted switch.
G. Grille: Aluminum with baked white enamel finish.
H. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.5 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with acoustic insulation, resiliently-mounted motor, gravity backdraft damper in discharge.
B. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor and wall mounted switch.
C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.
D. Provide flexible duct connections at inlet and outlet of fan.
E. Provide housed spring isolators for fan support.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Secure roof exhausters with stainless steel lag screws to roof curb. See drawings for additional mounting requirements.
C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
D. Provide sheaves required for final air balance.
E. Provide speed control on direct drive fans required for final air balance.
F. Install backdraft dampers on inlet to roof exhausters.
G. Provide backdraft dampers on outlet from cabinet and ceiling exhaust fans and as indicated.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers
B. Registers/grilles
C. Door grilles.
D. Gravity ventilators.

1.2 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 09 91 23 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

A. ADC 1062: GRD - Test Code for Grilles, Registers & Diffusers; Air Diffusion Council; 1984.
B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012 (Reapproved 2015).
C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.
D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers 2022.
E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets 2006 (Reaffirmed 2021).
F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
J. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
K. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.
L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

1.4 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.

B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.

1.5 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
C. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
B. Test and rate louver performance in accordance with AMCA 500-L.
C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Krueger-HVAC: www.krueger-hvac.com/#sle.
B. Price Industries: www.price-hvac.com/#sle.
C. Ruskin Company: www.ruskin.com/#sle.
D. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
E. Tuttle and Bailey: www.tuttleandbailey.com/#sle.

2.2 **DIFFUSERS**

A. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.
B. Fabrication: Steel or aluminum with baked enamel finish.
C. Color by Architect.
D. Accessories: Provide radial opposed blade, butterfly, combination splitter, and volume control damper; removable core, sectorizing baffle, safety chain, wire guard, equalizing grid, operating rod extension, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.
E. SEE DRAWINGS FOR DIFFUSER SPECIFICATIONS.

2.3 **REGISTERS/GRILLES**

A. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.
B. Fabrication: Steel or aluminum with baked enamel finish.
C. Color by Architect.
D. Accessories: Provide radial opposed blade, butterfly, combination splitter, and volume control damper; removable core, sectorizing baffle, safety chain, wire guard, equalizing grid, operating rod extension, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.

E. SEE DRAWINGS FOR REGISTER/GRILLE SPECIFICATIONS.

2.4 DOOR GRILLES

A. Type: V-shaped louvers of 20 gauge, 0.0359 inch thick steel, 1 inch deep on 1/2 inch centers.
B. Frame: 20 gauge, 0.0359 inch steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.5 GRAVITY VENTILATORS

A. Hood Intake and Relief Gravity Ventilator:
   1. Manufacturers:
      a. Greenheck Fan Corporation: www.greenheck.com/#sle.
      b. Loren Cook Company: www.lorencook.com/#sle.
   2. General:
      a. Low silhouette for intake and relief applications with natural gravity or negative pressure system(s).
      b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
      c. Suitable for non-ducted applications.
      d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
   3. Hood and Base:
      a. Material: Aluminum.
      b. Hood Construction: Precision formed, arched panels with interlocking seams.
      c. Vertical End Panels: Fully locked into hood end panels.
   4. Birdscreen:
      a. Fabricate in accordance with ASTM B221 (ASTM B221M).
      b. Construction: 1/2 inch Galvanized mesh.
      c. Horizontally mounted across hood intake area.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
D. Install diffusers to ductwork with air tight connection.
E. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
F. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 91 23.

END OF SECTION

SECTION 23 81 26

SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air-source heat pumps.
B. Air cooled condensing units.
C. Indoor air handling (fan and coil) units for ducted systems.

1.2 RELATED REQUIREMENTS

A. Section 23 31 00 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units 2004.
C. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant 2019.
D. NEMA MG 1 - Motors and Generators 2021.
E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
D. Design Data: Indicate refrigerant pipe sizing.
E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in ABC's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Carrier Corporation: www.carrier.com/#sle.
B. Daikin: www.daikin.com.

2.2 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
   1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator.
   2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
B. Performance Requirements: See Drawings for additional requirements.
   1. Efficiency:
      a. Minimum Energy Efficiency Ratio: 11.7.

2.3 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
   1. Air Flow Configuration: Upflow.
   2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
   1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
   2. Motor Electrical Characteristics:
C. Air Filters: 1 inch thick glass fiber disposable type arranged for easy replacement.
D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
   1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
   2. Manufacturers: System manufacturer.

2.4 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Comply with AHRI 210/240.
   2. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
    1. Provide thermostatic expansion valves.
    2. Provide heat pump reversing valves.
D. Operating Controls:
    1. Control by room thermostat to maintain room temperature setting.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
B. Verify that proper power supply is available and in correct location.
C. Verify that proper fuel supply is available for connection.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
B. Install in accordance with NFPA 90A and NFPA 90B.

END OF SECTION

SECTION 23 81 29

VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air-source outdoor units.
B. Refrigerant piping.
C. Indoor units.

1.2 RELATED REQUIREMENTS

A. Section 23 07 19 - HVAC Piping Insulation.
B. Section 23 23 00 - Refrigerant Piping.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
B. AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment 2021.
C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2019, with All Amendments and Errata.
E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants 2019.
F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata and Amendments (2022).
H. ITS (DIR) - Directory of Listed Products Current Edition.
I. UL 1995 - Heating and Cooling Equipment Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Division 1 specifications for submittal procedures.
B. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents.
C. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.

B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Compressors: Provide manufacturer's warranty for 6 years from date of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Daikin.

B. or equal.

2.2 VARIABLE REFRIGERANT FLOW SYSTEM

A. Minimum System Requirements:
   1. System Testing, Capacity Rating, and Performance:
      a. AHRI 1230 when cooling capacity is equal or greater than 65,000 Btu/h.
      b. AHRI 210/240 when cooling capacity is below 65,000 Btu/h.
   2. Safety Certification: Bear UL 1995 tested and ITS (DIR) listed certification label.
   3. Outdoor Units: Furnish installation and surface support hardware products in accordance with ASCE 7 for wind restraint.
   4. Cooling Mode Interior Performance:
      a. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F.
      b. Setpoint Range: 57 degrees F to 77 degrees F.
      c. Night Setback: 78 degrees F.
      d. Interior Relative Humidity: 20 percent, maximum.
   5. Heating Mode Interior Performance:
      a. Setpoint: 68 degrees F, plus or minus 2 degrees F.
      b. Setpoint Range: 59 to 80 degrees F.
      c. Night Setback: 60 degrees F.
      d. Minimum Interior Relative Humidity: 10 percent RH.

B. System Design and Installation Considerations:
   1. Conditioned spaces and zones are indicated on drawings.
   2. Outside unit locations are indicated on drawings.
   3. Indoor unit locations are indicated on drawings.
   4. Branch refrigerant unit locations are indicated on drawings.
   5. Required equipment unit capacities are indicated on drawings.
   6. Refrigerant piping sizes are not indicated on drawings.
   7. Condensate piping to nearest drain is indicated on drawings.

2.3 AIR-SOURCE OUTDOOR UNITS

A. Manufacturers:
   1. Air Conditioner, Cooling Outdoor Units:
      a. Daikin: www.daikinac.com/#sle.

B. Air Conditioning Type:

1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.

C. Unit Cabinet:
   1. Capable of being installed with wiring and piping to the left, right, rear or bottom.
   2. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
   3. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
   4. Sound Pressure Level: 55 dB measured at 3 feet from front of unit.

D. Heat Sink Side:
   1. Condenser Fans:
      a. Provide minimum of 2 fans for each condenser within the outdoor unit.
      b. Minimum External Static Pressure: Factory set at 0.12 in-wc.
      c. Fan Type: Vertical discharging, direct-driven propeller type with variable speed operation using DC-controlled ECM motors mechanically connected using permanently lubricated bearings having whole assembly protected with fan guards.
   2. Condenser Coils:
      a. Hi-X seamless copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.
      b. Corrosion Protection: Fins coated with anticorrosion acrylic resin and hydrophilic film type E1; pipe plates coated with polyester powder coating of 2.0 to 3.0 microns thickness.

E. Refrigeration Side:
   1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).
   2. Refrigeration Circuit: ECM driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
   3. Refrigerant: R-410a factory charged. Controller to alarm when charge is below capacity.
   4. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
   5. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
   6. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
   7. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
   8. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload

relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.

9. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.

2.4 REFRIGERANT PIPING

A. Three-Pipe Run: Provide low-pressure vapor, high-pressure vapor gas, and liquid pipes for each indoor unit selected for off-season heating and cooling changeover service.

B. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

C. Minimum Requirements:

1. Control direction of refrigerant flow using electronic expansion valves; use of solenoid valves for changeover and pressure equalization is not permitted due to refrigerant noise; use of multi-port branch selector boxes is not permitted unless spare ports are provided for redundancy.
2. Provide one electronic expansion valve for each downstream indoor unit served except when multiple indoor units are connected, provide balancing joints in downstream piping to keep total capacity within branch unit capacity.
3. Energize subcooling heat exchanger during simultaneous heating and cooling service.
4. Casing: Galvanized steel sheet with flame and heat resistant foamed polyethylene sound and thermal insulation.
5. Refrigerant Connections: Braze type.
6. Condensate Drainage: Provide unit that does not require condensate drainage.

2.5 INDOOR UNITS

A. Minimum Unit Requirements:

1. DX Evaporator Coil:
   a. Copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
   b. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch and flare end-connections.
   c. Provide thermistor on liquid and gas lines wired into local controller.
   d. Refrigerant circuits factory-charged with dehydrated air for field charging.
2. Fan Section:
   a. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
   b. Thermally protected, direct-drive motor with statically and dynamically balanced fan blades.
   c. Minimum-adjustable external static pressure 0.32 in-wc; provide for mounting of field-installed ducts.
3. Return Air Filter:
   a. Provide air filter rack for non-manufacturer's standard filters.
4. Condensate:

a. Built-in condensate drain pan with PVC drain connection for drainage.
b. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
c. Units Without Built-In Condensate Pump: Provide built-in condensate float switch and wiring connections.

5. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
C. Coordinate with installers of systems and equipment connecting to this system.
D. Coordinate BAS, BMS, or Integrated Automation linking between local controller(s) and remote front-end interface.

3.2 SYSTEM STARTUP

A. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
B. Adjust equipment for proper operation within manufacturer's published tolerances.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 CONTRACT PROVISIONS

A. The requirements of this Section are in addition to the requirements of Division 1, General Conditions and Supplementary Conditions.

1.2 SUMMARY

A. This section describes the requirements for the electrical work includes, among others, the furnishing and installation of the following:
   1. Power distribution system.
   2. Grounding system.
   3. Lighting and lighting control systems.
   4. Wiring systems including power wiring to plumbing and HVAC and other misc. appliances and equipment.
   5. Electrical services for Computer data systems, as described in Division 28 and as indicated on the drawings to include outlets, raceways, and cabling.
   6. Electrical services for Intrusion alarm and security systems as described in Division 28 and as indicated on the drawings.
   7. Emergency egress lighting.
   8. Fire alarm system.
   9. Emergency Power System.
   10. Testing and commissioning for all electrical work installed under this contract and as described in these specifications and indicated on the drawings.

B. Furnish and install all electrical equipment and systems as shown on the Drawings and as described in this Division of the Specifications to provide a complete and functional electrical installation. This work includes but is not limited to all material and labor required for installation of electrical and special systems complete as described herein this specification and drawings; and connections (and installation where not otherwise provided for) of electrical equipment furnished by others. Provide and install all items of equipment, devices, supports, etc., which are incidental to the major components shown on the Drawings or described in these Specifications.

C. Related Sections

D. Section 26 08 00 – Electrical Commissioning Requirements

1.3 DEFINITIONS

A. The meaning of words shall be as defined in the CEC Article 100, Definitions, unless defined otherwise in an individual specification section.

B. The following specification development organizations are referenced throughout the various specification sections of Division 26:
   1. ADAAG – Americans with Disabilities Act Accessibility Guidelines.
   2. Air Pollution Control District, Air Quality Management District.
   3. ANSI – American National Standards Institute.
   4. AQMD – Air Quality Management District.
   5. ASME – American Society of Mechanical Engineers.

6. ASTM – American Society for Testing and Materials.
7. CBC – California Building Code.
8. 10. CCR – California Code of Regulations Title 24 State Chapters.
9. 11. CEC – California Electrical Code.
10. 12. CFC – California Fire Code.
11. 13. CMC – California Mechanical Code.
12. 15. EIA – Electronic Industries Association.
13. 21. IEEE – Institute of Electrical and Electronic Engineers.
14. 24. ISO – International Organization for Standardization.
15. 27. NECA – National Electrical Contractors Association.
16. 28. NEMA – National Electrical Manufacturing Association.
17. 29. NETA – National Electrical Testing Association.
18. 30. NFPA – National Fire Protection Association.
19. 31. NIST – National Institute of Standards and Technology.
20. 32. OSHA – Occupational Safety and Health Administration.
21. 34. UL – Underwriters Laboratories.

1.4 RELATED WORK INCLUDED IN OTHER DIVISIONS

A. Finish painting except factory applied finishes and repair of factory finishes shall be provided in accordance with appropriate sections of this Specification. Coordinate "painting" requirements of this Division with other trades as required to assure timely and satisfactory completion of required work. In finished areas, all exposed raceway, boxes, galvanized steel box covers (where allowed), and other electrical "structure" shall be finished to match adjacent structures. Verify that all raceway openings are closed and box covers are in place prior to finishing work done by others.

B. Examine the drawings and specification for mechanical and plumbing equipment and provide electrical installation for heating, ventilation and air conditioning equipment, motors, pumps and associated motor starters and controls as described in Division 22 and Division 23.

C. Examine the Architectural drawings and specification for electrical appliances and equipment which may not be shown on the plans to include and provide electrical installations as described in the architectural division of work.

D. Examine the Architectural drawings and provide all construction necessary to maintain the integrity of the fire rated barriers.

E. Examine the Architectural drawings and coordinate with the Architect to provide access doors, whether shown on drawings or not, where floors, walls, or ceiling must be penetrated for access to electrical equipment, outlet boxes, devices, etc., and as specified in this specification.

F. Provide and install, as part of the work described in this Division, all power and control wiring fed from a source of 30 Volts or more (i.e. all wiring except temperature control wiring) for mechanical equipment described in Division 23.

G. Examine the fire sprinkler system drawings and specifications for electrical work which may not be shown on the electrical and/or fire detection and alarm plans to be included in the electrical work as necessary as described in the Division 21 fire sprinkler system.

1.5 APPLICATION OF OTHER DIVISIONS

A. Where carpentry, masonry, concrete work, painting, etc., is required in the installation of equipment specified under this Division, the work shall be done in accordance with the applicable Division of these Specifications. This work could include for example:

work associated with panelboard installation, equipment pads or bases, support structures, etc.

1.6 DRAWINGS AND SPECIFICATIONS

A. The information presented in these Specifications, and on the drawings, is intended to describe the utilitarian and physical aspects of the systems shown as well as the quality of the entire installation. All information is as complete and thorough as possible, but every condition or situation cannot be anticipated. Exact locations, dimensions, elevations, etc. must be determined "on the job" with careful attention to the "intent" of the Drawings and Specifications.

B. The above paragraph shall not be construed as to allow significant deviation from either the Drawings or Specifications without prior approval of the Architect, but minor changes in conduit routing or equipment locations may be required or desired due to specific conditions encountered. This work shall be accomplished in accordance with these Specifications and no "extra charges" are to be created for any unanticipated labor or material.

C. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical systems.

D. Contractor shall inspect the site and verify all measurements and conditions. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.

1. The Drawings are diagrammatic in nature, but the locations of devices, equipment, outlets, and lighting fixtures are shown approximately where installations are intended. Architectural, structural, mechanical, audio/video, theatrical lighting and other drawings shall be examined, noting all conditions that may affect this work. Report conflicting conditions to the Architect/Engineer for adjustment before proceeding with the work. Should the Contractor proceed with work without reporting the matter, he does so on his own responsibility and shall alter work if directed by the Architect/Engineer at his own expense.

E. Examine the architectural, structural, mechanical, fire sprinkler and manufacturer's drawings for various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.

F. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to rough in without incurring any additional cost or changes.

G. If significant departures from the Drawings or Specifications are considered necessary by the Contractor, details of the changes and the reasons therefore shall be submitted to the Architect as within thirty days after award of contract. Prior written acceptance of the Architect is required for these departures.

H. Clarification of plans and specifications for the purpose of facilitating construction, but not involving additional labor and materials, may be prepared during construction by the Architect/Engineer. Said revised plans and specifications shall become a part of the contract. The Contractor shall conform to the revised plans and specifications at no additional cost to the Owner.

1.7 CODES, STANDARDS, RULES AND REGULATIONS

A. All work and materials shall be in full accordance with the latest rules, codes, and/or regulations and not limited to the following:
B. NFPA 70 - National Electrical Code; National Fire Protection Association, 2017 with 2019 California Electrical Code amendments
C. NFPA 101 - Life Safety Code
D. NFPA 72 - Fire Alarm Code
E. Title 24 - State of California Administrative Code
F. Uniform Building Code (UBC) OR California Building Code (CBC)
G. City or County Electrical Code as applicable.
H. Utility rules and regulations.
I. Any applicable additional codes and regulatory documents effective at the project site.
J. Nothing on the Drawings or in the Specifications shall be construed to allow work not in conformance with these rules, codes, and regulations.
    1. The Drawings and/or Specifications shall take precedence where work and material described therein exceeds that required by rules, codes, or regulations.

1.8 MANUFACTURER'S INSTRUCTIONS

A. Follow the manufacturer's instructions when specific installation or connection details are not indicated or specified on the contract documents.
B. Notify the Architect/Engineer of conflicts between the manufacturer's instructions and installation or connection details prior to the installation of materials.

1.9 WORKMANSHIP

A. High quality workmanship shall be evidenced in the installation of all electrical equipment and materials. Use the National Electrical Contractors Association's "Standard of Installation" as a guide to the workmanship required. Be prepared to replace or repair any material or equipment damaged by or installed in a manner exhibiting evidence of poor workmanship.

1.10 COORDINATION WITH OTHER TRADES

A. Examine the Electrical Drawings and refer to the Drawings and Specifications describing other work to be accomplished. Verify and coordinate prior to bid. Continue to coordinate work planning and all work in the field to avoid conflicts, errors, and/or delays. No compensation will be allowed for extra work necessitated by lack of coordination.

1.11 AUTHORITY OF THE ARCHITECT

A. As used in this paragraph only, the word "Architect" shall mean the Architect of record or his designated representative.
B. The authority of the Architect shall be absolute with respect to all performance under this Specification. In case of dispute, the decision of the Architect shall be final.
C. Where optional materials, methods, or installation techniques are allowed under the provisions of this Specification, they may be used at the discretion of the Architect. The Architect may require specific materials, methods, or techniques to be used in specific situations where use of other materials, methods, or techniques might in his judgment result in loss of aesthetics, accidental damage, life safety hazard, or loss of utility over the system design lifetime.

D. No additional charges will be allowed for work or material require to be supplied under the conditions of this paragraph unless the need for such material or work could not have been anticipated by thorough study of the site, Drawings, and Specifications and knowledge of all applicable codes, laws, and ordinances.

1.12 EXAMINATION OF THE SITE

A. The contractor is required to visit the site of construction prior to bid to determine existing conditions and their effect upon the work he will be required to perform. No additional compensation will be allowed for any extra expenses incurred by failure to detect and evaluate all existing conditions that will affect his work to be included in the bid to accomplish this contract document's goal.

1.13 STRUCTURAL REQUIREMENTS

A. Secure all anchors for electrical equipment in a manner, which will not decrease the structural value of any structure to an unsafe level. Install all equipment, fixtures, etc. to resist seismic movements. Inform the Architect in advance and provide drawings of any proposed modifications to the structure that involves cutting or patching of concrete, masonry, steel, or wood in this project.

1.14 PERMITS, FEES, AND, INSPECTIONS

A. Obtain all permits and licenses as required and pay all fees incidental to construction.
B. Inspections required by prevailing Local Authorities, and/or ordinances, shall be coordinated and arranged by the contractor. Provide the Architect with a schedule of inspections, where applicable, and submit all certificates of inspection to the Architect.
C. The Contractor shall cooperate with the Architect and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate equipment, or perform any reasonable work, which, in the opinion of the Architect, will be necessary to determine the quality or adequacy of the work. Work shall not be closed in or covered before inspection and approval by the Architect. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Architect, remove the materials from the premises.

1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable to the Owner. Secure material from weather or accidental damage.

1.16 SEQUENCING AND SCHEDULING

A. Sequence work under provisions of Division 1.
B. Coordinate the incoming electrical, telephone and cable television services with the local serving utility companies. Install utility service trench and duct systems in accordance with the respective serving utility company requirements.
C. Coordinate hand hole locations with the existing site conditions. Hand holes are to be located approximately five feet from building or as indicated on drawings.

1.17 SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

A. The Contractor shall be responsible for obtaining all pertinent information necessary in order to perform the required short circuit, protective device coordination and arc flash studies to include but not limited to the following:
   1. Contacting the serving power utility to obtain the available short circuit current at the project point of connection and/or secondary of the serving utility company service transformer(s).
   2. Field investigation to determine the short circuit current rating for any existing electrical service and distribution equipment.
   3. Electrical characteristics for all proposed new electrical service and distribution equipment.
   4. The Contractor shall provide approved permanent labels for all electrical service and distribution equipment to clearly identify the available short circuit current and arc flash energy levels and required PPE (Personnel Protective Equipment).

1.18 OPERATING INSTRUCTIONS

A. Instruct the Owner as to function, operation, maintenance, and adjustment of each system and piece of equipment provided.

1.19 RECORD DRAWING

A. The Contractor shall keep a separate set of Electrical Drawings at the job site to be used as RECORD Drawings. These Drawings are to be kept current and in a neat and clean condition at all times. They are to be available for inspection by the Architect or Engineer at any time during site visitations. These Drawings shall be "red lined" to indicate all changes in equipment, device, and outlet locations; and to indicate the true locations of all concealed or underground work where different from that shown on the Drawings. Each sheet of this set shall be clearly and permanently marked "RECORD DRAWINGS".
B. Upon completion of the project and prior to final payment, transfer all RECORD DRAWINGS information to the provided original drawings. All information shall be clearly drawn with “RED” ink. The drawings shall be scanned, 100% edited, and converted into an AutoCAD “.dwg” version 2011 (or higher) electronic file. Deliver the original, final sets, and electronic files (CD) to the Architect for review and delivery to the Owner.

1.20 SPARE PARTS

A. Spare parts shall be provided and maintained by the Contractor to support the maintenance response requirements defined in this document.
B. At a minimum, the following spare parts shall be stored onsite at a location identified by the Owner’s representative. The spare parts shall be the property of the Owner. The spare parts shall be of the same type submitted and installed in the facility to include the following:
C. Lighting fixture LED driver, one for each fixture type.
D. Branch circuit panelboard circuit breaker, one for each circuit breaker type.
E. Fuses, one set of three for each fuse type and size.
F. Lighting occupancy sensors and switches, one for each sensor and switch type.

1.21 GUARANTEE

A. All electrical work, material, and equipment shall be guaranteed to be free from defects in workmanship or material for a period of two (2) year from the date of final acceptance. Repair or replace all such defects in a timely manner and any damage to the owner's property resulting from such defect or repair thereof. All equipment and material provided and all work accomplished under the requirements of this section shall be at no expense to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless specifically indicated otherwise, all material shall be new and free from defects; it shall be listed by Underwriters' Laboratories where applicable. Like items shall be of the same manufacturer (except lighting fixtures - which shall be as specified).
B. Except as noted otherwise, where material of a particular manufacturer is specified, the intent is to describe the quality and function of the item. The term "...or acceptable equal" is implied. A substitution of any of these items will require that the item be presented in a submittal whether specifically listed in the "Submittals" paragraph below or not.

2.2 SUBMITTALS

A. Material submittals shall be complete and submitted all at the same time. The individual groups of submittal types (e.g.: lighting fixtures, wiring devices, distribution equipment, etc.) MUST be prefaced with a list of contents identifying each item by its project name or symbol, manufacturer, and complete catalog number. Each copy of each submittal group shall have the list of contents attached. These lists will be used to report submittal comments. The Contractor is responsible for submitting this information in a timely manner so that material may be ordered early enough to meet the construction schedule. If material is not ordered in time for whatever reason, pay such premium prices and special handling charges as are required to meet the construction schedule. No substitution of an "accepted" item will be allowed due to failure to plan for adequate material procurement lead time.
B. Shop drawings shall be drawn to scale or completely dimensioned and shall give all information required to completely describe the item. The Contractor shall carefully check all the shop drawings for compliance with these specifications and the Plans.
C. If the shop drawings show variations from the Contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in order that if (acceptable) suitable action may be taken for proper adjustment of the Contract. The Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract, even though the shop drawings have been reviewed.
D. Work requiring shop drawings shall not be started before receipt of the Architect's review and acceptance.
E. The Architect's/Engineer's review of the submitted materials, items and shop drawings are for general compliance with the plans and specifications and general design and arrangement only. Therefore, it shall not relieve the Contractor from responsibility for errors of any sort in the materials, items, shop drawings or schedules. The Contractor shall verify all dimensions and job site conditions affecting the work, and shall be responsible for furnishing and installing the proper materials required by the Contract,

whether or not indicated on the drawings and specifications.

F. As a minimum, submittals are required for the following items:
   1. RACEWAY COMPONENTS
   2. WIRE AND CABLE
   3. WIRING DEVICES
   4. PANELBOARDS
   5. PULL BOXES
   6. SAFETY SWITCHES, DISCONNECTS AND CIRCUIT BREAKERS
   7. LIGHTING FIXTURES, CONTROL SYSTEMS, PEDESTALS AND POLES
   8. FIRE ALARM SYSTEM
   9. COMMUNICATIONS SYSTEM
   10. SECURITY SYSTEM
   11. DATA DISTRIBUTION SYSTEM
   12. TERMINAL CABINETS

2.3 SUBSTITUTIONS

A. Specific brand names and catalog numbers are used to describe materials in order to establish of performance and quality.
B. Only one substitution will be considered for any item. Substitute materials must be equal in quality and function to that specified. Allowance of a substitution does not permit any reduction of system performance or utility, and the Contractor is responsible for additional costs incurred due to use of a substituted item. If the proposed substitute item is "rejected", the specified item shall be provided (re-submittal required) without further discussions or delay.
C. Any Contractor's proposed substitution of material, article, or method in the opinion of the Architect/Engineer are equal to that specified will be accepted, provided the Contractor submits a single written request, in triplicate, to the Architect, with the following information for each item:
D. Name of Manufacturer or supplier.
E. Trade or brand names.
F. Type, model, style, and/or catalog number.
   1. Size or capacity rating.
G. After receipt of a written request from the contractor, the engineer of record will review product substitutions fourteen (14) days prior to the bid date. If system substitutions are submitted after the award of the project contract, the analysis for the whole system substitution will be charged to the contractor at senior engineer hourly rates.
H. The decision of the Architect/Engineer shall govern as to what is equal to the item specified in the plans and specifications. Equality will be judge on the basis of the following:
   1. Conformance with description or performance required.
   2. Equal in quality.
   3. Comparable in appearance and artistic effect where these are in considerations.
   4. Comparable operation, maintenance and performance.
   5. Equal in longevity and service under conditions of climate and usage.
   6. Conformance with space allocations and requirements for operations from in details and construction of related work.
   7. Conformance with all applicable codes and regulations.
I. If the Architect/Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased

laboratory, satisfactory to the Architect.

2.4 ENCLOSURES

A. Provide enclosures suitable for the specific type of location in which they are installed.
   1. Provide NEMA 1 or NEMA 12 boxes and enclosures for dry locations. Dry locations are all indoor areas that do not fall within the definitions below for wet or damp locations.
   2. Provide NEMA 3R boxes and enclosures for wet locations. Wet locations are all locations exposed to weather, whether under a roof or not.
   3. Provide NEMA 4 boxes and enclosures for damp locations. Damp locations are all indoor spaces wholly or partially underground or any area subject to water spray.
   4. Provide NEMA 4X, stainless steel enclosures in all kitchen and wash down areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be set square and plumb, securely mounted, adequately supported, and permanent. Provide workspace around items of electrical equipment as required by California Electrical Code (CEC). In general, equipment is to be installed in accordance with manufacturer's instructions; but the requirements of these specifications shall take precedence where conflicts exist.
B. WIRING METHODS: The cables and conductors of all systems specified in the Specification are required to be installed in raceway.
C. Coordinate electrical work with the Owner’s representative and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the facility during construction.
D. Check and coordinate the approximate locations of electrical stub-ups, light fixtures, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the architect in writing. The architect’s decision shall govern. Make modifications and changes required to correct conflicts as required.

3.2 ELECTRICAL WORK FOR EQUIPMENT PROVIDED UNDER OTHER SECTIONS

A. Install power conductors and terminate on equipment provided under other specification sections. Verify specific requirements.
B. Install and terminate electrical controls as described on the Electrical Drawings (For mechanical equipment specified in Division 23).
C. Line voltage control wiring of exhaust fans is to be accomplished under this Division. The controlling device may be specified elsewhere.
D. Provide and install all disconnect/safety switches and motor starters except those devices specified to be furnished with equipment specified elsewhere.
E. Unless provided for in another Division, install all items of electrical equipment provided by others.
F. Assist others in equipment testing to verify that wiring and connections made under this Division are correct.

3.3 EQUIPMENT IDENTIFICATION

A. Nameplates shall be installed on all items of electrical equipment as follows: switchboard(s) and switchboard circuit breakers, panelboards, terminal cabinets, time switches, contactors, motor control switches, wall switches (where noted on the Drawings), motor starters provided under this Division where the function is not immediately obvious, and safety switches.
B. The nameplate shall identify the item by Drawing name where applicable and describe its use or function in this installation.
C. Permanently mark all utility outlets to show source of power panel and circuit breaker number.
D. Provide nameplates per Section 26 05 53.

3.4 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be accomplished as required for installation of electrical equipment as shown on the Drawings. Restore all surfaces, roadways, walks, etc., and any existing underground structures which might be disturbed during this work to their original condition in a manner acceptable to the Architect.
B. Trenches shall be straight except where otherwise indicated. Depth shall be as noted on the Drawings and at least as required to provide the minimum cover specified by applicable codes and regulations for the equipment installed. Bottom of trench shall be smooth and free of any rock points. Place a 4" sand bed in trench if these conditions cannot be met with native material.
C. Backfill shall be clean and free of rocks and debris. Backfill is to be tamped in 6" layers to nominal 95% compaction using a mechanical tamper manufactured specifically for this purpose. In an area of engineered fill or other area of specified compaction, backfill shall be compacted to match that specified for that area.
D. At a depth of 12" below finished grade and at least 6" above installed equipment, lay a 6" wide yellow warning tape on the compacted backfill for the full length of the trench. Do not stretch the tape. Use Brady "Identoline" stating: "CAUTION BURIED ELECTRICAL LINE". Installation under building slabs is not required unless noted otherwise.
E. If at any time during a period of one-year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, the Architect may notify the Contractor to immediately provide additional fill and to make such repairs or replacements in paving, planting, or structures, as may be deemed necessary at the Contractor's expense.
F. Cooperate and coordinate with others in planning for and execution of all trench work.
    1. The Contractor is expected to exercise due care when excavating in an area of existing utilities to avoid damage to these facilities. Where it can be determined that underground facilities are likely to exist (either from the Drawings or inspection of the site), the Contractor is required to determine the exact locations of these existing installations. Damage to existing facilities, due to failure to properly accomplish the above, shall be repaired at the Contractors expense to the approval by the Architect and satisfaction of the Owner.
    2. CALL AN UNDERGROUND SERVICE FIRM BEFORE TRENCHING, CALL U.S.A. (800) 624-2444.

3.5 SEALING PENETRATIONS

A. Flash and counter flash roof and wall penetrations with equipment manufactured for the purpose and as described in other Divisions of these Specifications or as Directed by the Architect. Apply mastic as required to seal absolutely watertight.
B. Conduits penetrating floor slabs or block or concrete walls shall be grouted and sealed watertight.

3.6 CUTTING AND PATCHING

A. Obtain the Architect's acceptance prior to cutting existing surfaces or surfaces under construction. All such surfaces must be repaired or patched to the satisfaction of the Architect.

3.7 EQUIPMENT ANCHORING

A. Seismic Withstand Requirements: Freestanding or wall-hung equipment shall be anchored in place by methods, which will meet the requirements of the Uniform Building code for seismic loads. The CONTRACTOR shall submit calculations in accordance with “Contractor Submittals”, for the design of the anchoring systems for all equipment, including panels, transformers, etc. in excess of 250 pounds. Calculations shall be performed, signed and stamped by a Structural Engineer or a Civil Engineer experienced in structural design and licensed in the State of California. The calculation shall provide an analysis of lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. The calculation shall also provide an analysis of both the anchoring system and the foundation or wall system to receive the anchor loads and shall show that the foundation is capable of resisting all anchor loads. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria.
B. Seismic bracing for light fixtures cable or pendant suspended from ceiling or roof structure shall be seismically braced to prevent fixture from swaying 45 degree in either direction of suspension point. Contractor shall use same cable used to suspend light fixture. Where pendants are use the contractor shall use air craft light fixture suspension cable. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria referred to in above paragraph.

3.8 HOUSEKEEPING PADS AND FOUNDATIONS

A. Concrete work required for housekeeping pads and foundations shall be provided by General Construction Work.
B. Furnish required dimensional drawings and specify locations for all equipment pads and foundations. Minimum height of housekeeping pads shall be four inches and shall extend out six inches from the footprint of the equipment. Extend pad dimensions where required to maintain accessibility and meet all code requirements.
C. Furnish anchor bolts and sleeves, verify accuracy of installation.
D. Provide housekeeping pads for the following:
    1. Outdoor distribution panels.
    2. Other equipment as required or as noted on the drawings.

3.9 PROTECTION CLEANING AND REPAIRS

A. All electrical equipment shall be protected from damage or degradation during construction. Electrical equipment stored or installed shall be protected from dust,

water, or damage from other sources.

B. After all other work has been accomplished, such as plastering, painting, etc., and prior to final review by the Architect; all electrical equipment, especially equipment enclosures, panelboards, switchboards, and lighting fixtures shall be thoroughly cleaned (inside and out) of all dirt, water, grease, plaster, paint, or other construction debris. All surfaces shall be clean and in "new" condition. All scratches, dents, marks, cracks, etc., shall be repaired to the satisfaction of the Architect or the equipment shall be replaced at no additional cost.

3.10 ELECTRICAL EQUIPMENT DELIVERABLES

A. Retain and safeguard all detachable and spare devices, equipment, and literature (O&M manuals, instruction books, wiring diagrams, test reports, keys, fixtures, etc.) until completion of work. At this time, all items will be delivered to the Owner as directed by the Architect.

3.11 TESTS

A. Prior to energization of equipment, check the insulation resistance of listed circuits, with a 500 volt “Megger”.
B. Take precaution during the testing period to insure the safety of personnel and equipment.
C. Test all wiring for continuity and grounds before any fixtures or equipment are connected. Where such tests indicate faulty installation or other defects, the fault(s) shall be located and repaired at the Contractor's expense. The repaired installation shall then be retested.
D. Verify rotation of all three phase motors and reconnect if necessary.
E. Verify the resistance of the grounding electrode system(s).
F. Balance all loads on each panelboard and all other types of distribution equipment as applicable.
G. Provide all site testing under provisions of Section 26 08 00.

3.12 ADJUSTING

A. Adjust work under provisions of Section 26 08 00.
B. Inspect all equipment and put into good working order.

3.13 CLEANING

A. Clean work under provisions of Division 1.
B. Clean all electrical items. Fixtures and equipment shall be free of dirt, dust and other construction debris.

3.14 START UP

A. Operate all electrical systems in good working order for a period of five consecutive days at a time period agreed to by the Owner’s representative.

END OF SECTION

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.
B. The requirements of this Section are in addition to the requirements of Division 1 – General Conditions and Supplementary Conditions.

1.2 RELATED REQUIREMENTS

A. Section 02 41 13-Selective Site Demolition.
B. Section 26 05 00-Common Work Results for Electrical.

1.3 SUBMITTALS

A. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

1.4 REQUIREMENTS INCLUDED

A. The Contractor shall furnish materials, equipment, and labor necessary to perform and complete demolition work.
B. The work includes demolition of the existing electrical and fire alarm systems and equipment.
C. The work shall include, but not limited to. Removal of existing electrical and fire alarm equipment and devices, conduits, and wiring.
D. Manufactured articles, materials, equipment, and accessories shall be demolished in accordance with the manufacturer’s specifications ad recommendations, and industry standards.
E. Notify the Owner’s Representative at least 72 hours prior to any electrical systems shutdown and receive approval prior to proceeding.

1.5 PROTECTION

A. It is essential that there be minimal interruption of existing systems such as power, fire protection, and other systems, in addition to the normal operations of the Owner’s facilities.
B. Take care to ensure that there will be no damage to structural elements or portions there-of-which are not to be removed. Erect and maintain temporary shoring, bracing and other means to safeguard the structural integrity of the existing building(s) and structures.
C. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other means to protect the public, workers, and other persons; finishes, and improvements to remain; and adjoining property from damage from demolition work; all in accordance with applicable regulatory requirements.
D. Protect existing structures, facilities, and plant life from damage. Items damaged as a result of demolition operations shall be repaired or replaced, at no cost to the Owner.
E. Perform demolition to provide the least interference and most protection to existing facilities and improvements to remain.

F. Demolish concrete in small sections.
G. Perform demolition as much as possible with small tools.
H. Jackhammering:
    1. Jackhammering will be permitted only to a limited degree, and only with the prior written approval of the Owner.
    2. Do not jackhammer within 2-inches of reinforcing or structural steel to remain; remove final 2-inches of material with chipping gun.

1.6 CUTTING AND PATCHING

A. Make new openings neat, as close as possible to profiles indicated, and only to extent necessary for new work.
B. Do not cut or alter structural members unless specifically indicated or approved, and do not damage reinforcing or structural steel to remain.
C. At concrete, masonry, paving, and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power-sawing and coring equipment. Do not over cut at corners of cut openings – saw overruns will not be permitted. Core hole at corner of proposed openings to insert blade and chip square.
D. Upon completion of cutting and coring, clean remaining surfaces of loose particles and dust.
E. Repair and patch all holes and openings from the removed electrical equipment, outlet boxes, etc.: Coordinate with the General Contractor and Architect to include and provide finishes to match adjacent surfaces.

1.7 PIPES, DUCTS AND CONDUITS

A. Remove deactivated electrical conduits, including fasteners, connections, and other related appurtenances and accessories which would otherwise be exposed in the completed work or interfere with construction operations.
B. Unless noted otherwise, remove existing exposed conduits and abandon existing concealed conduits in walls, ceilings and underground whether shown on drawings or not.
C. Cap deactivated piping systems at point of cutoff.

1.8 **DEMOLITION DEBRIS**

A. All demolished equipment and associated materials must be disposed of in an approved manner and in accordance with all applicable federal, state and local laws.
B. Regularly remove debris from the site so that it’s presence will not delay the progress of the work.
C. Nothing removed from the site shall be stored, sold, or burned on site without the Owner’s prior written acceptance.

1.9 RECONDITIONING EXISTING SUBSTRATES

A. Clean surfaces on which new materials will be applied, removing adhesives, bitumen, and other adhering materials, as necessary to furnish acceptable substrates for new materials.
B. Perform sandblasting, chipping, grinding, acid washing, etching, and other work as required by conditions encountered and new materials involved.
C. Use of acids or other cleaning agents shall include neutralizing, washing, rinsing, and drying, as applicable.

D. Determine substrate requirements for reconditioned surfaces in cooperation with the manufacturer's representative and installer of each new installer involved.

1.10 DISPOSAL OF FLUORESCENT LAMPS AND BALLASTS

A. All existing fluorescent lamps and ballasts shall be properly disposed or recycled according to the Environmental Protection Agency (EPA) and Resource Conservation and Recovery Act (RCTA) standards. Include all costs for disposal or recycling in the bid proposal.
   1. Lamps: Dispose or recycle through "Allied Technology Group", 47375 Freemont Blvd., Freemont, CA, 94538, (510) 490-3008 or equal.
   2. Ballasts: Dispose or recycle through "Fulcircle Ballast Recyclers", 550 Montori Court, Pleasanton, CA, 94556, (510) 417-5967 or equal.

1.11 ASBESTOS

A. In the event asbestos is found to be present in areas conflicting with electrical work, before continuation of work in these areas, notify the General Contractor and/or Owner's Representative and if applicable, for the removal of such hazardous material by a certified asbestos contractor.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.
B. Verify that abandoned wiring and equipment serve only abandoned facilities.
C. Demolition drawings are based on field observation and existing record documents.
D. Report discrepancies to Architect and Owner before disturbing existing installation.
E. Report discrepancies to Electrical Engineer on Record before disturbing existing installation.
F. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
B. Coordinate utility service outages with utility company.
C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner Representative at least 24 hours and receive approval before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.
   3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION 260501

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scope: furnish all labor, materials, equipment, and incidentals required to install wire and cable for a complete operable electrical system as shown on the drawings and as described in the specifications.
B. Section Includes:
   1. Single conductor building wire
   2. Underground feeder and branch-circuit cable.
   3. Wire and cable for 600 volts and less.
   4. Wiring connectors.
   5. Electrical tape.
   6. Heat shrink tubing.
   7. Oxide inhibiting compound.
   8. Wire pulling lubricant.
   9. Cable ties.
   10. Firestop sleeves.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00-Common Work Results for Electrical.
B. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
E. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
E. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
F. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

I. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
J. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
K. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
L. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables Current Edition, Including All Revisions.
M. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   4. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
E. Product Data: Provide for each cable assembly type.
F. Test Reports: Indicate procedures and values obtained.
G. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
H. Field Quality Control Test Reports.
I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
J. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
K. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. All wire and cable shall comply with applicable standards of the Underwriters Laboratories Inc.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify the Electrical Engineer or Record and obtain direction before proceeding with work.

1.9 PROJECT CONIDTIONS

A. Existing Conditions
   1. Wire and cable routing shown on the Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
   2. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
B. Verify that field measurements are as shown or indicated on the Drawings.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
C. Concealed Dry Interior Locations: Use only building wire in raceway.
D. Exposed Dry Interior Locations: Use only building wire in raceway.
E. Above Accessible Ceilings: Use only building wire in raceway.
F. Wet or Damp Interior Locations: Use only building wire in raceway.
G. Exterior Locations: Use only building wire with Type THWN insulation in raceway.
H. Underground Installations: Use only building wire with Type THWN insulation in raceway.
I. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
J. Use stranded conductors for control circuits.
K. Use conductor not smaller than 12 AWG for power and lighting circuits.
L. Use conductor not smaller than 14 AWG for control circuits.
M. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
N. Conductor sizes are based on copper unless indicated as aluminum or "AL".

2.2 WIRE MANUFACTURERS (LISTED IN ALPHABETICALLY ORDER ONLY AND NOT NECESSARY BY PREFERENCE)

A. Cerro Wire LLC: www.cerrowire.com.
B. Industrial Wire & Cable, Inc: www.iewc.com.
C. Southwire Company: www.southwire.com.
D. Or Equal.

2.3 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.
B. Provide products listed, classified, and labeled as suitable for the purpose intended.
C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
D. Comply with NEMA WC 70.
E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
F. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
G. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
H. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
I. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
J. Conductor Material:
    1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
    2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
K. Minimum Conductor Size:
    1. Branch Circuits: 12 AWG.
        a. Exceptions:
            1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
            2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
    2. Control Circuits: 14 AWG.
L. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
M. Conductor Color Coding:
    1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
    2. Color Coding Method: Integrally colored insulation.
        a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
    3. Color Code:
        a. 208Y/120 V, 3 Phase, 4 Wire System:
            1) Phase A: Black.

2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.

b. Equipment Ground, All Systems: Green.
c. Isolated Ground, All Systems: Green with yellow stripe.
d. Travelers for 3-Way and 4-Way Switching: Pink.
e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
f. For control circuits, comply with manufacturer's recommended color code.

2.4 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
d. Southwire Company: www.southwire.com/#sle.
B. Description: Single conductor insulated wire.
C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.
D. Insulation Voltage Rating: 600 V.
E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.
a. Size 4 AWG and Larger: Type XHHW-2.
b. Installed Underground: Type XHHW-2.
c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
F. Conductor: Copper.
G. Insulation Voltage Rating: 600 volts.
H. Insulation: NFPA 70, Type THHN/THWN.

2.5 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
C. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
3. Connectors for Aluminum Conductors: Use compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

H. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
   1. Manufacturers:
      a. Ideal Industries, Inc: www.idealindustries.com/#sle.
      b. NSI Industries LLC: www.nsiindustries.com/#sle.
      c. Wago Corporation: www.wago.us/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

I. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC; _____: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC; _____: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.

d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC; _____: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

L. Power Conductor Splicers
1. Blackburn.
2. Burndy “Hylug”.
3. Ilso.
4. O.Z. Gedney.

2.6 ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
c. Or approved equal.
d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Burndy LLC; _____: www.burndy.com/#sle.

c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Or approved equal.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC; _____: www.burndy.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. Ilsco: www.ilsco.com/#sle.
d. Or approved equal.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. American Polywater Corporation: www.polywater.com/#sle.
c. Ideal Industries, Inc: www.idealindustries.com/#sle.
d. Or approved equal.

E. Cable Ties: Material and tensile strength rating suitable for application.
1. Manufacturers:
a. Burndy LLC; _____: www.burndy.com/#sle.
b. Scotchflex.
c. Thomas & Betts.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
1. Products:
a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
1. Products:
a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.
B. Verify that work likely to damage wire and cable has been completed.
C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
D. Verify that raceway installation is complete and supported.
E. Verify that field measurements are as indicated.
F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
      b. Increase size of conductors as required to account for ampacity derating.
      c. Size raceways, boxes, etc. to accommodate conductors.
   8. Common Neutrals: Sharing of neutral/grounded conductors among branch circuits is not permitted.
B. Install products in accordance with manufacturer's instructions.
C. Perform work in accordance with NECA 1 (general workmanship).
D. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
G. Install conductors with a minimum of 12 inches of slack at each outlet.

H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
K. Make wiring connections using specified wiring connectors.
    1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
    2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
    3. Do not remove conductor strands to facilitate insertion into connector.
    4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
    5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
    6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
    1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
        b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
    2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
        a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
        b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
    3. Wet Locations: Use heat shrink tubing.
M. Insulate ends of spare conductors using vinyl insulating electrical tape.
N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
O. Identify conductors and cables in accordance with Section 26 05 53.
P. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
Q. Install firestopping to preserve fire resistance rating of partitions and other element.

R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
S. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
T. Route wire and cable as required to meet project conditions.
    1. Wire and cable routing indicated is approximate unless dimensioned.
    2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
    3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.
U. Use wiring methods indicated.
V. Pull all conductors into raceway at same time.
W. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
X. Protect exposed cable from damage.
Y. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
Z. Use suitable cable fittings and connectors.
AA. Neatly train and lace wiring inside boxes, equipment, and panelboards.
BB. Clean conductor surfaces before installing lugs and connectors.
CC. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
DD. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
EE. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
FF. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
GG. Identify and color code wire and cable under provisions of Section 26 0553. Identify each conductor with its circuit number or other designation indicated.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
    1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
C. Correct deficiencies and replace damaged or defective conductors and cables.
D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION 260519

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Scope: provide a complete grounding and bonding system as shown on the electrical drawings and as described in the specifications such that the entire raceway system including all equipment enclosures, data racks, telephone backboards and cabinets, fixtures, and outlets, etc. are effectively connected to ground.
B. Grounding and bonding requirements.
C. Section includes:
    1. Materials and methods for grounding systems and equipment.
    2. Grounding electrodes and conductors.
    3. Equipment ground conductors.
    4. Bonding
D. Connectors for grounding and bonding.
E. Ground bars.
F. Provide all components necessary to complete the grounding system(s) consisting of:
    1. Existing metal underground water pipe.
    2. Metal frame of the building.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00-Common Work Results for Electrical.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
    1. Includes oxide inhibiting compound.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
D. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2022.
C. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.
1. Building grounding electrode: 10 ohms.
2. Separately Derived Sources Grounding Electrode: 10 ohms

1.6 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
B. Shop Drawings:
1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
C. Product Data: Provide for grounding electrodes and connections.
D. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
F. Field quality control test reports.
G. Project Record Documents: Record actual locations of grounding electrode system components and connections.
H. Project Record Documents: Record actual locations of components and grounding electrodes.
I. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.7 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
E. Grounding System Resistance:
    1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Electrical Engineer of Record. Precipitation within the previous 48 hours does not constitute normally dry conditions.
    2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
    3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
F. Grounding Electrode System:
    1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
        a. Provide continuous grounding electrode conductors without splice or joint.
        b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
    2. Metal Underground Water Pipe(s):
        a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
        b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
        c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
    3. Metal In-Ground Support Structure:
        a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
    4. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
        a. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.

b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
b. Metal gas piping.
c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

H. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    a. Exceptions:
        1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors for accessible connections.
    a. Exceptions:
        1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
    a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
    b. Burndy LLC: www.burndy.com/#sle.
    c. Harger Lightning & Grounding: www.harger.com/#sle.
    d. Thomas & Betts Corporation: www.tnb.com/#sle.
    e. Or approved equal.
    f. Substitutions: See Section 01 60 00 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
    c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
    d. Or approved equal.
    e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
    a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
    b. Erico International Corporation: www.erico.com/#sle.
    c. Harger Lightning & Grounding: www.harger.com/#sle.
    d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
    e. Or approved equal.

2.3 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.
B. Framatome Connectors International: www.fciconnect.com.
C. Or approved equal.

2.4 ELECTRODES

A. Manufacturers:
1. Cooper Power Systems: www.cooperpower.com.
2. Framatome Connectors International: www.fciconnect.com.
3. Or approved equal.

B. Rod Electrodes: Copper.
1. Diameter: 3/4 inch.

2. Length: 10 feet.

C. Foundation Electrodes: 3/0 AWG. unless noted on plan.

2.5 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.
B. Exothermic Connections:
C. Wire: Stranded copper.
D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.
B. Verify that field measurements are as indicated.
C. Verify that conditions are satisfactory for installation prior to starting work.
D. Verify existing conditions prior to beginning work.
E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Bonding
   1. Provide bonding to meet requirements of CEC.
   2. Bond together metal siding not attached to grounded structure, bond to ground.
   3. Bond prefabricated metal building to grounding electrode system at a minimum of one location.
   4. Bond together all metallic conduit, boxes, cabinets, and enclosures.
D. Grounding Conductors
   1. Provide grounding conductor for each branch circuit indicated.
   2. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder circuit raceway and within each motor feeder raceway. Terminate each end on suitable lug, bus, or bushing.
   3. Provide separate, isolated grounding conductor for each circuit which is installed (all or in part) in non-metallic conduit.
   4. Provide separate grounding conductor for circuits installed in flexible steel conduit. Terminate each end on a suitable lug, bus or bushing.
   5. Ground all conduit systems, cabinets, equipment, motor frames, etc., in accordance with CEC and applicable codes.
E. Grounding Connections
   1. Ground shields of shielded power cable and signal cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer.
   2. Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting

pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.

3. Ground all fencing as shown on the grounding details on the Drawings.
4. Bond neutrals of transformers within buildings to the system ground network, and to additional indicated grounding electrodes.
5. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade.
6. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground. Make connections of other grounding conductors generally accessible.
7. In manhole pull boxes, install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.
8. When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint. Re-galvanize area if required. For compression connectors, use homogeneous copper, anti-corrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify the Owner's Representative prior to backfilling any ground connections.
9. Grounding pad plates shall be cast into the slab with the surface flush with the finished floor.

F. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
   3. Provide ground well for future access to rod electrodes.

G. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

H. Identify grounding and bonding system components in accordance with Section 26 05 53.

I. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

J. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing . Bond steel together.
K. Provide bonding to meet requirements described in Quality Assurance.
L. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.13.
C. Site Tests:
    1. Test under provisions of Section 26 08 00.
    2. Notify the Owner's Representative five days before inspection and testing.
    3. Use suitable test instruments to measure resistance to ground of systems. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
    4. Remove main bonding jumper at main service switchboard and at each separately derived system and test for infinite resistance between neutral and ground systems. Reconnect bonding jumper(s) after completion of testing.
    5. Record test results in accordance with Section 26 05 00 and submit.
D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 260526

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
B. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
C. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
D. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2022.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
F. MFMA-4 - Metal Framing Standards Publication 2004.
G. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.
H. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006
I. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010
J. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.
K. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
N. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
C. Design Data
   1. Indicate hanger and support framing and attachment methods.
   2. Submit seismic and structural calculations for proposed methods of support and attachment.
D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.
E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
F. Installer's Qualification Statement: Include evidence of compliance with specified requirements.
G. Product Data: Provide manufacturer’s catalog data for fastening systems.
H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Conform to requirements of CEC.
B. Conform to requirements of NFPA 70.
C. Comply with applicable building code.
D. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
E. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25%. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Or approved equal

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.

d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
e. Thomas & Betts Corporation: www.tnb.com/#sle.
f. Or approved equal.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.
6. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Or approved equal.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

E. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Channel Material: Use polyester resin or vinyl ester resin.
2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
4. Manufacturers:
a. Enduro Composites: www.endurocomposites.com/#sle.
b. Or approved equal.
c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch diameter.
b. Busway Supports: 1/2 inch diameter.
c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
f. Outlet Boxes: 1/4 inch diameter.
g. Luminaires: 1/4 inch diameter.

G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
4. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Erico International Corporation: www.erico.com/#sle.
   c. PHP Systems/Design: www.phpsd.com/#sle.
   d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
   e. Or approved equal.
   f. Substitutions: See Section 01 60 00 - Product Requirements.

H. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
    a. Where approved by Electrical Engineer of Record.
11. Hammer-driven anchors and fasteners are not permitted.
    a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
    b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
    d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Or approved equal.

f. Substitutions: See Section 01 60 00 - Product Requirements.

15. Manufacturers - Powder-Actuated Fastening Systems:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Or approved equal.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MANUFACTURERS (LISTED IN ALPHABETICALLY ORDER ONLY AND NOT NECESSARY BY PREFERENCE)

A. Thomas & Betts Corporation: www.tnb.com.
B. Threaded Rod Company: www.threadedrod.com.
C. Or Approved Equal.

2.3 SUPPORTS

A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket.
B. Pipe racks for groups of parallel conduits shall be constructed of galvanized structural steel preformed channels of length as required, suspended on threaded rods and secured thereto with nuts above and below the cross bar.
C. Factory made pipe straps shall be one hole malleable iron or two hole galvanized clamps.
D. Supporting rods shall be at least 3/8" diameter and channel shall be at least 3/4" deep. Supporting hardware shall be galvanized steel.

2.4 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
B. Supports: Fabricated of structural steel or formed steel members; galvanized.
C. Anchors and Fasteners:
    1. Sheet Metal Screws: Steel
    2. Machine Screws Bolts, Nuts and Washers: Steel
    3. Precast Inserts: Suitable for the purpose.
    4. Anchor Bolts, expansion type (stainless steel).
        a. Phillips Red-Head
        b. Hilti Kwik-Bolt.
        c. WEJ-IT.
    5. Cast-in-Place Anchors: Suitable for the purpose (hot-dip galvanized except cadmium plated in dry locations)
    6. Beam Clamps: Steel.
    7. Detention Fasteners: In accordance with Section 11 19 23.
D. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
E. Steel Structural Elements: Use beam clamps or welded fasteners.

F. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
G. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
H. Solid Masonry Walls: Use expansion anchors or preset inserts.
I. Sheet Metal: Use sheet metal screws.
J. Wood Elements: Use wood screws.
K. Fastener Types:
    1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
    2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
    3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
    4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
    5. Other Types: As required.
    6. Manufacturers:
        a. Powers Fasteners, Inc: www.powers.com.
        b. Or approved equal.
L. Formed Steel Channel as indicated on drawings.
M. Powder-Actuated Anchors: As indicated on drawings
N. Steel Spring Clips: As indicated on drawings

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. General
    1. Install products in accordance with manufacturer's instructions.
    2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
    3. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
    1. Concrete – Precast inserts, cast-place anchors, or expansion type anchor bolts.
        a. When installing drilled-in anchors in non-prestresses reinforced concrete, avoid the reinforcing bars.
        b. When installing drilled-in anchors into prestressed concrete (Pre- or Post-tensioned) locate tendons by using a non-destructive method prior to installation. Maintain a minimum clearance of one-inch between the reinforcement and the drilled-in anchor.
    2. Sheet Metal – Sheet metal screws or machine bolts, nuts, and washers.
    3. Structural Steel Members – Beam clamps, machine screws, bolts, nuts, and washers.
D. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.
F. Field-Welding (where approved by LP Consulting Engineers, Inc.): Comply with Section 05 50 00.
G. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
    6. Install surface mounted cabinets and panelboards with minimum of four anchors.
    7. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 13/16-inch minimum off wall.
    8. Use sheet metal channels to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
    9. Support equipment in accordance with manufacturer's instructions.
    10. Verify that equipment will fit support layouts indicated.
        a. Where suitable equipment is used, revise indicated supports to fit at no additional cost.
    11. Arrange for necessary openings to allow entry of equipment.
        a. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, or other devices to allow for later installation.
H. Conduit Support and Attachment
    1. In damp or wet locations, space conduit support directly from concrete or metal structure out at least ¼ inch using straps with spacers or, if three (3) or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of a channel.
    2. Runs of individual conduit suspended from the floor or ceiling shall be supported with pipe hangers. Where three (3) or more conduits are suspended from the floor or ceiling, suitable racks shall be constructed from channel material with suitable fittings.
    3. Space supporting points no greater than required by CEC.
I. Sleeves
    1. Set sleeves in position in formwork. Provide reinforcing around sleeves.
    2. Extend sleeves through floors 1 inch above finished floor levels. Caulk sleeves full depth and provide floor plate.
    3. Where raceway penetrated floor, ceiling, or wall. Close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal.
J. Conduit Support and Attachment: Also comply with Section 26 05 33.13.
K. Box Support and Attachment: Also comply with Section 26 05 33.16.
L. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
M. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.

N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
O. Secure fasteners according to manufacturer's recommended torque settings.
P. Remove temporary supports.
Q. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.
B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
C. Correct deficiencies and replace damaged or defective support and attachment components.
   1. Obtain permission from the Architect and the Structural Engineer before drilling or cutting structural members.
D. All expansion anchors shall have 50 percent of the bolts (alternate bolts in any group arrangement) proof tested in tension and certified by a recognized testing agency at the values indicated in the following table, except where shown otherwise in the Contract Documents. If there are any failures, the immediately adjacent bolts must then also be tested. Anchor capacities shall not exceed 80 percent of the values in the published ICBO report.

ANCHOR CAPACITY (3,000 PSI MINIMUM STONE AGGREGATE CONCRETE)							
	1/2 inch	5/8 inch	3/4 inch	7/8 inch	1 inch	1-1/4 inches	UNITS
IN TENSION	680	960	1,360	1,900	2,700	3,600	LBS
IN SHEAR	1,170	1,680	2,420	3,500	5,020	6,700	LBS
TYPE OF TEST:							
DIRECT PULL-TENSION, LBS.	1,360	1,920	2,720	3,800	5,400	7,200	LBS
MINIMUM EMBEDMENT	3	3-3/4	4-1/2	5-1/4	6	7-1/2	INCHES

END OF SECTION 260529

SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Scope: Provide rigid metallic conduit, rigid non-metallic conduit, intermediate metal conduit, flexible metal conduit, electrical metallic tubing, surface metal and/or non-metallic raceways, cable tray and wireways as shown on the drawings and as described in the specifications.

1.2 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Flexible metal conduit (FMC).
C. Liquidtight flexible metal conduit (LFMC).
D. Electrical metallic tubing (EMT).
E. Rigid polyvinyl chloride (PVC) conduit.
F. Conduit fittings.
G. Accessories.
H. Conduit, fittings and conduit bodies.

1.3 RELATED REQUIREMENTS

A. Section 26 05 00 – Common Work Results for Electrical.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.
D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
E. Section 26 05 33.16 - Boxes for Electrical Systems.
F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.4 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit 2018.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.

I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
J. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series 2015.
K. NEMA TC 14.AG - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2021).
L. NEMA TC 14.BG - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2020).
M. NEMA TC 14.XW - Extra Heavy Wall Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2021).
N. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
P. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
Q. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
R. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
S. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
T. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
U. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.6 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
B. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
   2. Include proposed locations of roof penetrations and proposed methods for sealing.

C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.
D. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, fittings, and conduit bodies.
E. Project Record Documents: Accurately record actual routing of conduits larger than 1 1/4 inches.

1.7 QUALITY ASSURANCE

A. Conform to requirements of CEC.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
B. Accept conduit on site. Inspect for damage.
C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
D. Protect PVC conduit from sunlight.

1.9 PROJECT CONDITIONS

A. Verify that field measurements are as shown on drawings.
B. Verify conduit routing and termination locations of conduits prior to rough in.
C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring systems.

1.10 RATED WALLS AND CEILINGS

A. Inspect architectural plans for locations and fire ratings for all walls, ceilings, and floors. Install materials as required to maintain the fire integrity of the rated assemblies.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
C. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
D. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

E. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
    1. Locations subject to physical damage include, but are not limited to:
        a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
        b. Where exposed below 20 feet in warehouse areas.
        c. In Correctional Facilities, Galvanized rigid steel only for inmate accessible areas. Locations shall be verified with the architect.
I. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.
J. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
K. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
    1. Corrosive locations include, but are not limited to:
        a. Cooling towers.
L. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
    1. Maximum Length: 6 feet.
M. Connections to Vibrating Equipment:
    1. Dry Locations: Use flexible metal conduit.
    2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
    3. Maximum Length: 6 feet unless otherwise indicated.
    4. Vibrating equipment includes, but is not limited to:
        a. Transformers.
        b. Motors.
        c. Engine generators.
N. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.
O. Freezer and Refrigeration Rooms
    1. Galvanized rigid steel conduit.
    2. Use sealing fittings on refrigeration and freezer room conduit runs in accordance with CEC 300-7(a).

2.2 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
B. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.
C. Provide products listed, classified, and labeled as suitable for the purpose intended.
D. Minimum Conduit Size, Unless Otherwise Indicated:
    1. Branch Circuits: 1/2 inch (16 mm) trade size.
    2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
    3. Control Circuits: 1/2 inch (16 mm) trade size.
    4. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.

5. Underground, Interior: 1 inch (27 mm) trade size.
6. Underground, Exterior: 1 inch (27 mm) trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
5. Or approved equal.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. Appleton.
c. Crouse-Hinds.
d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
e. Thomas & Betts Corporation: www.tnb.com/#sle. (for reference, Thomas & Betts series numbers are listed in this section)
f. Or approved equal.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Where an expansion type fitting is not required, use a coupling or “Erickson” type coupling as appropriate. Threadless set screw and compression (gland) type fittings are not permitted.
5. At building expansion joints, use expansion type fittings.
6. Make connections to NEMA 12 boxes with a threaded hub.

D. Locknuts
1. Hardened Steel or malleable iron construction, electro zinc plated, capable of insuring positive bond to enclosure.
a. Non-bonding: T & B Series 142 or approved equal.
b. Bonding: T & B Series 107 or approved equal.

E. Bushings
1. Insulted: T & B Series 223 or approved equal.
2. Insulated Metallic Bushing: T & B Series 1223 or approved equal.
3. Insulated Grounding and Bonding Bushing: T & B Series 3871 or approved equal.

F. Couplings
1. Non-metallic Conduit Coupling: By non-metallic conduit manufacturer for the application.
2. Threaded Rigid Metal Conduit Couplings: By conduit manufacturer for the application.

3. Threadless Coupling: “Erickson” Type Y & B Series 676 or approved equal.
4. Expansion Type: Permit ¾ inch movement any direction.
   a. Exposed: Weatherproof with external bonding jumper.
   b. Embedded: Watertight with internal bonding jumper.

G. Connectors
1. Non-Metallic Conduit Connector: By conduit manufacturer for the application.
2. Threaded Hubs: Electro zinc coated with nylon insulated throat and ail/moisture resistant recessed sealing ring, raintight.
   a. Non-bonding: T & B Series 371 or approved equal.
   b. Bonding: T & B Series 371 with 107 series bonding locknut or approved equals.

H. Nipple: “Chase” Type, insulated: T & B Series 5263 or approved equal.
I. Sealing Gaskets: Oil and moisture resistant rubber bonded to metallic retainer.
1. With rigid conduit – T & B Series 5303 or approved equal.
2. Fittings not specifically listed but required shall be of similar style and quality.

2.4 METAL CONDUIT

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedtube.com.
2. Beck Manufacturing, Inc: www.beckmfg.com.
3. Wheatland Tube Company: www.wheatland.com.
4. Or Equal.

B. Rigid Steel Conduit: ANSI C80.1.
C. Intermediate Metal Conduit (IMC): Rigid steel.
D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Or approved equal.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
C. Fittings:
1. Manufacturers:
   a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
   b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
   c. Thomas & Betts Corporation: www.tnb.com/#sle.
   d. Or approved equal.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.

D. Description: Interlocked steel construction.
E. Connectors and Fittings: NEMA FB 1.

1. Flexible metal conduit connector – Insulated throat, suitable as grounding means: T & B Serries 3115.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
   2. Electri-Flex Company: www.electriflex.com/#sle.
   3. International Metal Hose: www.metalhose.com/#sle.
   4. Or approved equal.
   5. Substitutions: See Section 01 60 00 - Product Requirements.
B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
D. Description: Interlocked steel construction with PVC jacket.
E. Fittings: NEMA FB 1.

2.7 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Nucor Tubular Products: www.nucortubular/#sle.
   3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
   4. Beck Manufacturing, Inc: www.beckmfg.com.
   5. Wheatland Tube Company: www.wheatland.com/#sle.
   6. Or Equal.
   7. Substitutions: See Section 01 60 00 - Product Requirements.
B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   4. Connectors and Couplings: Use compression (gland) or set-screw type.

a. Do not use indenter type connectors and couplings.
b. Do not use set-screw type connectors and couplings.
c. EMT Coupling: Raintight T & B Series 5220 or approved equal.
d. EMT to Rigid Metal Conduit Connector, Raintight: T & B Series 531 or approved equal.

5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

D. Description: ANSI C80.3; galvanized tubing.
E. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Cantex Inc: www.cantexinc.com/#sle.
2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
3. JM Eagle: www.jmeagle.com/#sle.
4. Or approved equal.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
1. Internal to fittings
a. Approved by manufacturer for application.
2. Manufacturer
a. Crouse-Hinds Chico A-P and Chico X fiber.
b. O.Z. Gedney.
c. Or approved equal.

G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
   1. Products:
      a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
      b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
      c. Or approved equal.

I. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
   1. Manufacturers:
      a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
      b. Or approved equal.

J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
   1. Products:
      a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
      b. Or approved equal.

K. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
      b. Or approved equal.

L. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
      b. Or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive conduits.
C. Verify that conditions are satisfactory for installation prior to starting work.
D. Verify routing and termination locations of conduit prior to rough-in.
E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
G. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
H. Conduit Routing:
    1. Unless dimensioned, conduit routing indicated is diagrammatic.
    2. When conduit destination is indicated without specific routing, determine exact routing required.
    3. Conceal all conduits unless specifically indicated to be exposed.
    4. Conduits in the following areas may be exposed, unless otherwise indicated:
        a. Electrical rooms.
        b. Mechanical equipment rooms.
        c. Within joists in areas with no ceiling.
    5. Unless otherwise approved, do not route conduits exposed:
        a. Across floors.
        b. Across roofs.
        c. Across top of parapet walls.
        d. Across building exterior surfaces.
    6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
    7. Arrange conduit to maintain adequate headroom, clearances, and access.
    8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
    9. Arrange conduit to provide no more than 150 feet between pull points.
    10. Route conduits above water and drain piping where possible.
    11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
    12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
    13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
        a. Heaters.
        b. Hot water piping.
        c. Flues.
    14. Group parallel conduits in the same area together on a common rack.
I. Conduit Support:
    1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
10. Use of spring steel conduit clips for support of conduits is not permitted.
    a. Support of electrical metallic tubing (EMT) up to 1 inch (27 mm) trade size concealed above accessible ceilings and within hollow stud walls.
11. Use of wire for support of conduits is not permitted.
    a. For securing conduits to studs in hollow stud walls.
    b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).
12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.

M. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

N. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
O. Provide grounding and bonding in accordance with Section 26 05 26.
P. Identify conduits in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
C. Correct deficiencies and replace damaged or defective conduits.

3.4 EMPTY CONDUITS

A. Certain conduits will have no conductors pulled in as a part of this contract. Identify with tags at each end of the origin and destination of each such empty conduits. Provide a permanent cap over each end of each empty conduit. Provide a nylon pull wire in each empty conduit, tie off at both ends.

3.5 TESTING AND INSPECTION

A. So not cover up conduit work until inspected. Notify the Owner's Representative at least 3 days before desired inspection date.

3.6 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.7 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.
B. All conduuits shall be run concealed in walls and/or ceiling. Where conduits can not be run concealed in wall and/or ceiling space, the Constractor shall coordinate with the architectural and structural plans and the Architect for installing and routing of exposed conduits.

3.8 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

END OF SECTION 260534

SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Scope: Provide boxes, pull boxes, racks, and enclosures as shown on drawings or as required by code(s).
B. Section Includes:
C. Boxes and enclosures for integrated power, data, and audio/video.
D. Boxes for hazardous (classified) locations.
E. Floor boxes.
F. Underground boxes/enclosures.
G. Accessories.
H. Wall and ceiling outlet boxes.
I. Floor boxes.
J. Pull and junction boxes.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
C. Section 26 05 33.13 - Conduit for Electrical Systems:
    1. Conduit bodies and other fittings.
    2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
D. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
F. Section 26 27 26 - Wiring Devices:
    1. Wall plates.
    2. Floor box service fittings.
    3. Poke-through assemblies.
    4. Access floor boxes.
    5. Additional requirements for locating boxes for wiring devices.
G. Section 26 28 13 - Fuses: Spare fuse cabinets.
H. Section 26 2726 - Wiring Devices: Wall plates in finished areas.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).

F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports 2013 (Reaffirmed 2020).
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
I. SCTE 77 - Specifications for Underground Enclosure Integrity 2017.
J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
L. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
M. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
B. Samples:
   1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.
C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
D. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   6. Use suitable concrete type boxes where flush-mounted in concrete.
   7. Use suitable masonry type boxes where flush-mounted in masonry walls.
   8. Use raised covers suitable for the type of wall construction and device configuration where required.
   9. Use shallow boxes where required by the type of wall construction.
   10. Do not use "through-wall" boxes designed for access from both sides of wall.
   11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
16. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
    c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
17. Wall Plates: Comply with Section 26 27 26.
18. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
    c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.
    f. Or equal.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
    c. Kitchens and food prep. Locations: Type 4X, stainless steel, unpainted.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
    c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
    d. Or equal.

2.2 ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
   1. Manufacturers:
      a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
      b. Or approved equal.

2.3 MANUFACTURERS

A. Appleton Electric: www.appletonelec.com.
B. Arc-Co./Division of Arcade Technology: www.arc-co.com.
C. Unity Manufacturing: www.unitymfg.com.
D. Or approved equal.

2.4 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.
B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
C. Wall Plates for Finished Areas: As specified in Section 26 2726.

2.5 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.
B. Material: Cast metal.
C. Shape: Round.
D. Service Fittings: As specified in Section 26 2726.

2.6 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
B. Hinged Enclosures: As specified in Section 26 2716.
C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
   1. Material: Galvanized cast iron.
   2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
   3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Boxes are indicated in approximate locations only on the drawings unless specifically dimensioned. Verify all box locations prior to rough-in.
C. Verify that mounting surfaces are ready to receive boxes.
D. Verify that conditions are satisfactory for installation prior to starting work.
E. Verify locations of floor boxes and outlets prior to rough-in.
F. Verify locations of all boxes required for kitchen equipment with kithcen consultant plans and specifications.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
D. Provide separate boxes for emergency power and normal power systems.
E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
H. Box Locations:
    1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
    2. Unless dimensioned, box locations indicated are approximate.
    3. Locate boxes as required for devices installed under other sections or by others.
        a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
        b. Communications Systems Outlets: Comply with Section 27 10 00.
    4. Locate boxes so that wall plates do not span different building finishes.
    5. Locate boxes so that wall plates do not cross masonry joints.
    6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
    7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
    8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
    9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
        a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.

10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required seismic controls in accordance with Section 26 05 48.
3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

N. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

O. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.

5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

P. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
Q. Close unused box openings.
R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
S. Provide grounding and bonding in accordance with Section 26 05 26.
T. Identify boxes in accordance with Section 26 05 53.
U. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
V. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 72.
W. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.
X. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
Y. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet if required to accommodate intended purpose.
Z. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.
AA. Maintain headroom and present neat mechanical appearance.
BB. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
CC. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
DD. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
EE. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
FF. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
GG. Use flush mounting outlet box in finished areas.
HH. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
II. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in fire-rated and acoustic rated walls.
JJ. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
KK. Use stamped steel bridges to fasten flush mounting outlet box between studs.
LL. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
MM. Use adjustable steel channel fasteners for hung ceiling outlet box.
NN. Do not fasten boxes to ceiling support wires.
OO. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
PP. Use gang box where more than one device is mounted together. Do not use sectional box.
QQ. Use gang box with plaster ring for single device outlets.
RR. Use cast outlet box in exterior locations exposed to the weather and wet locations.

SS. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
TT. Set floor boxes level.
UU. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.
B. Adjust flush-mounting outlets to make front flush with finished wall material.
C. Install knockout closures in unused box openings.

3.4 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.5 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260537

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vibration isolation requirements.
B. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.
C. Vibration-isolated equipment support bases.
D. Vibration isolators.
E. External seismic snubber assemblies.
F. Anchoring and seismic restraint systems.

1.2 RELATED REQUIREMENTS

A. Section 26 05 00 - Common Work Results for Electrical.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
   1. Provide the work in compliance with CCR Title 24, Part 2, State Chapters, Drawings, and calculations to be stamped and signed by a California licensed structural engineer.
   2. Provide seismic restraints for the listed materials and equipment. The attachments shall resist forces to the center of gravity of the component. Criteria shall be the operating weight of the item times 0.5g for horizontal force to be applied in any direction. Wall-mounted or suspended components shall in addition, resist a downward force of 200 pounds minimum added to the operating weight of the component.

1.4 DEFINITIONS

A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).
B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.5 REFERENCE STANDARDS

A. ASTM E2265-2003 – Standard Terminology for Anchors and Fasteners in Concrete and Masonry.
B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
C. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. MFMA-4 - Metal Framing Standards Publication 2004.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.6 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   5. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
      b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
   6. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.7 SUBMITTALS

A. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
   2. Seismic Controls: Include seismic load capacities.
C. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
D. Shop Drawings - Seismic Controls:
   1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
   2. Identify mounting conditions required for equipment seismic qualification.
   3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
   4. Indicate proposed arrangement of distributed system trapeze support groupings.
   5. Indicate proposed locations for distributed system flexible fittings and/or connections.

6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

E. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
a. Component operating weight and center of gravity.
b. Component elevation in the building in relation to the roof elevation (z/h).
c. Component importance factor (Ip).
d. For distributed systems, component materials and connection methods.
e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

F. Certification for seismically qualified equipment; identify basis for certification.
G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
I. Evidence of qualifications for seismic controls designer.
J. Evidence of qualifications for manufacturer.
K. Manufacturer’s detailed field testing and inspection procedures.
L. Field quality control test reports.

1.8 QUALITY ASSURANCE

A. Comply with NFPA 70.
B. Comply with applicable building code.
C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
D. Seismic Controls Designer Qualifications: Registered professional engineer licensed in California and with minimum five years experience designing seismic restraints for nonstructural components.
1. Designer may be employed by the manufacturer of the seismic restraint products.
E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.
B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
C. General Requirements:
    1. Select vibration isolators to provide required static deflection.
    2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
    3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
    4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
    5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
D. Equipment Isolation:
    1. Transformers:
        a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
        b. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
        c. Minimum Static Deflection:
            1) Transformers Mounted on Grade-Level Slabs: 0.25 inch deflection unless otherwise indicated.
            2) Transformers Mounted at Above-Grade Levels: 0.5 inch deflection unless otherwise indicated.
E. Conduit Isolation:
    1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
        a. Minimum Length: 3 feet unless otherwise indicated.
    2. Vibration Isolators:
        a. Provide vibration isolators for conduit supports:
            1) Located within 50 feet of connected vibration-isolated equipment where flexible connection to equipment is not possible.
            2) For conduits over 2 inch trade size located below or within 50 feet of noise-sensitive areas indicated.
        b. Minimum Static Deflection:
            1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
            2) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
        c. Suspended Conduits, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.

d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.2 SEISMIC CONTROL REQUIREMENTS

A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
B. Seismic Design Criteria: ICC (IBC)/ASCE 7.
C. Component Importance Factor (Ip): Electrical components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
D. Component Importance Factor (Ip): Electrical components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
   1. Electrical components required to function for life safety purposes after an earthquake.
   2. Electrical components that support or otherwise contain hazardous substances.
E. Seismic Qualification of Equipment:
   1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
   2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
   3. Notify LP Consulting Engineers, Inc. and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
   4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
F. Seismic Restraints:
   1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
   2. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
   3. Seismic Type Vibration Isolators:
      a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
   4. External Seismic Snubber Assemblies:
      a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
      b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.

5. Seismic Restraint Systems:
    a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
    b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
    c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
    d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
    e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
    f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
    g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
    h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
    i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
    j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

G. Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
    a. Increase size of pad as required to comply with anchor requirements.
    b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

H. Seismic Interactions:

1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

I. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
a. Relative displacements at connections between components, including distributed systems (e.g., conduit, cable tray); do not exceed load limits for equipment utility connections.
b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
c. Design displacements at seismic separations.
d. Anticipated drifts between floors.

2.3 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
b. Mason Industries: www.mason-ind.com/#sle.
c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
d. Korfund Dynamics Corp.
e. Amber-Booth Co.
f. Consolidated Kinetics.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 03 30 00.

2.4 VIBRATION ISOLATORS

A. Manufacturers:
1. Vibration Isolators:
a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
b. Mason Industries: www.mason-ind.com/#sle.

c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
d. Korfund Dynamics Corp.
e. Amber-Booth Co.
f. Consolidated Kinetics.
g. Or approved equal.

2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
a. Color code or otherwise identify springs to indicate load capacity.
b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
f. Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
c. Furnished with integral leveling device for positioning and securing supported equipment.
d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:

a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.5 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
1. Seismic Restraint Systems:
a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
b. Eaton Corporation: www.eaton.com/#sle.
c. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
d. Mason Industries: www.mason-ind.com/#sle.
e. Or approved equal.
2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
C. Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.
D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

A. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.

1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

B. Seismic special inspections include, but are not limited to:
1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
2. Anchorage of electric equipment for emergency and standby power systems for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Anchorage of electrical equipment other than for emergency and standby power systems for Seismic Design Categories E and F; periodic inspection.
4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
5. Verification of required clearances between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

C. Seismic special inspections include, but are not limited to:
1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
2. Anchorage of electric equipment for emergency and standby power systems for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Anchorage of electrical equipment other than for emergency and standby power systems for Seismic Design Categories E and F; periodic inspection.
4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.

D. Special Inspection Agency services do not relieve from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
D. Secure fasteners according to manufacturer's recommended torque settings.
E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
F. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
a. Position equipment at operating height; provide temporary blocking as required.

b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.

3. Isolator Hangers:
   a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
   b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

G. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
   a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
   b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
   c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
   a. Size in accordance with seismic design to meet anchor requirements.
   b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
   a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
   b. Install restraints within permissible angles in accordance with seismic design.
   c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
   d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
   e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.4 FIELD QUALITY CONTROL

A. Inspect vibration isolation and/or seismic control components for damage and defects.
B. Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.
C. Vibration Isolation Systems:
    1. Verify isolator static deflections.
    2. Verify required clearance beneath vibration-isolated equipment support bases.
    3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates and labels.
B. Wire and cable markers.
C. Conduit markers.
D. Field-painted identification of conduit.

1.2 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association, 2017 with 2019 California Electrical Code amendments.

1.3 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Buried Electrical Lines: Underground warning tapes.
B. Communication Cabinets: Nameplates.
C. Conduit: Conduit markers.
D. Control Device Station: Labels.
E. Electrical Distribution and Control Equipment Enclosures: Nameplates.

2.2 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.
B. Seton Identification Products: www.seton.com/aec.
C. HellermannTyton: www.hellermanntyton.com.
D. Or equal.
E. Substitutions: See Section 016000 - Product Requirements.

2.3 NAMEPLATES AND LABELS

A. Manufacturers:
   1. Kolbi Pipe Marker Co.; www.kolbipipemarkers.com.
   2. Seton Identification Products; www.seton.com.
   3. Or Equal.
B. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
C. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Communication cabinets.

D. Letter Size:
   1. Use 1/8 inch letters for identifying individual equipment and loads.
   2. Use 1/4 inch letters for identifying grouped equipment and loads.
E. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations, and _____.

2.4 WIRE MARKERS

A. Manufacturers:
   1. Brady Corporation; www.bradycorp.com.
   2. Seton Identification Products; www.seton.com.
   3. HellermannTyton; www.hellermanntyton.com.
   4. Or Equal.
B. Description: Vinyl cloth type self-adhesive wire markers.
C. Description: Cloth type wire markers.
D. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
E. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.5 CONDUIT MARKERS

A. Manufacturers:
   1. Brady Corporation; www.bradycorp.com.
   2. Seton Identification Products; www.seton.com.
   3. HellermannTyton; www.hellermanntyton.com.
   4. Or Equal.
B. Location: Furnish markers for each conduit longer than 6 feet.
C. Spacing: 20 feet on center.
D. Color:
   1. Fire Alarm System: Red.

2.6 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Corporation; www.bradycorp.com.
   2. Seton Identification Products; www.seton.com.
   3. HellermannTyton; www.hellermanntyton.com.
   4. Or Equal.
B. Description: 3 inch wide polyethylene tape, detectable type colored red with suitable warning legend describing buried electrical lines.
C. Description: 4 inch wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

A. Install nameplates and labels parallel to equipment lines.
B. Secure nameplates to equipment front using screws.
C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.
D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.

END OF SECTION 260553

SECTION 26 08 00

ELECTRICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of this section is to specify the Contractor's responsibilities and participation in the commissioning process relative to division 26.
B. The commissioning process is primarily the responsibility of the Commissioning Authority, with support for start-up, testing, and commissioning the responsibility of the Contractors. The commissioning process does not relieve the Contractor from participation in the process, or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.
C. Work of Division 26 includes:
    1. Testing and start-up of the electrical equipment.
    2. Providing qualified personnel to assist in commissioning tests to verify equipment/ system performance.
    3. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
    4. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
    5. Providing training for the systems specified in Division 26 with coordination of owner by the Commissioning Authority.

1.2 RELATED WORK

A. All testing and start-up procedures and documentation requirements specified within Division 26.
B. Commissioning functional test procedures that require participation of the Contractors.
C. Cooperate with the Commissioning Authority in the following manner:
    1. Allow sufficient time before final completion dates so that testing can be accomplished.
    2. Provide labor and material to make corrections when required without undue delay.
    3. Coordinate all required support of that equipment which is provided to or installed with involvement of Division 23 contractors.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard certified test equipment for commissioning shall be provided by the Division 26 Contractor.
B. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Complete all phases of work so the system can be started, tested, balanced, and otherwise commissioned. Division 26 has temporary power and start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment and materials per the contract documents and related directives, clarifications, change orders, etc.

B. The Commissioning Authority will develop a Commissioning Plan. Upon request of the Commissioning Authority, the Contractor shall provide assistance and consultation. The Commissioning Plan will be developed prior to completion of the installation. The Contractor is obligated to assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation.

C. Specific pre-commissioning responsibilities of Division 26 are as follows:
   1. Normal start-up services required to bring each system into a fully operational state. The Commissioning Authority will not begin the commissioning process until each system is complete and documented, including normal contractor start-up.
   2. The Contractor shall perform pre-functional tests on the equipment and systems as noted in section 01 9100 General Commissioning Requirements.
   3. Contractor start-up forms may be substituted for the pre-functional test forms with prior approval by the Commissioning Authority.
   4. Pre-functional test forms will be kept in the Contractors job trailer in a Commissioning Field Notebook provided by the Commissioning Authority.
   5. Factory start-up services will be provided for key equipment and systems specified in Division 26. The Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

E. The Field Commissioning Notebook will be used to identify and track all pertinent commissioning documentation required during the Installation phase. This Notebook will be assembled by the Commissioning Authority and maintained by the Contractor. The Notebook provides a central location for the Commissioning Authority to identify, copy and organize all pertinent information and will include the following format:
   1. Summary describing Notebook contents and use.
   2. Copy of Commissioning Plan for contractor field reference.
   3. Listing of all specification documentation requirements listed by specification section, with sign off spots for appropriate contractors.
   4. Tabs for each specification section with copies of pre-functional test check sheets provided by coordination of subcontractors and Commissioning Authority for contractor completion and space for related contractor-supplied documents.
   5. Prior to functional testing the Commissioning Authority will use this book to verify that all appropriate contractors have completed their work and signed off that they have done so. Once the Commissioning Authority is satisfied that all components of a system are complete functional testing will begin.

3.2 PARTICIPATION IN COMMISSIONING

A. Provide skilled technicians to start up and debug all systems within the division of work. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.3 WORK TO RESOLVE DEFICIENCIES

A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet the original design intent. Correction of work will be completed under the direction of the Architect, with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance and or design intent.

3.4 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

3.5 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required to demonstrate performance.

C. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.6 TRAINING

A. The Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.
B. Training will be conducted jointly with the Commissioning Authority, the design engineers, the equipment vendors, and the Contractor. The Contractor will be responsible for the generic training, as well as instructing the Owner's staff on the system peculiarities specific to this project.

3.7 SYSTEMS DOCUMENTATION

A. Contract Documents to incorporate field changes and revisions to system designs to account for actual constructed configurations will be addressed as required in Division 1. All drawings should be red-lined on two sets. Division 26 as-built drawings should include updated architectural floor plans, and the individual electrical systems in relation to actual building layout.
B. Maintain as-built red-lines on the job site as required in Division 1.
C. In addition to the stated requirements for operation and maintenance data, provide one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner's final use.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.
B. Time switches.
C. In-wall time switches.
D. Outdoor photo controls.
E. Daylighting controls.

1.2 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260537 - Boxes.
C. Section 260553 - Identification for Electrical Systems: Labels for lighting control devices.
D. Section 262716 - Electrical Cabinets and Enclosures.
E. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, fan speed controllers, and wall plates.
F. Section 265100 - Interior Lighting.
G. Section 265600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2006.
B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).
C. NECA 1 - Good Workmanship in Electrical Construction; 2006.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.
E. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts; National Electrical Manufacturers Association; 2004.
F. NFPA 70 - National Electrical Code; National Fire Protection Association 2017 with amendments from the 2019 California Electrical Code (CEC).
G. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
H. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
I. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
    2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.

3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify the Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
C. Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
D. Field Quality Control Reports.
E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
F. Operation and Maintenance Data: Include detailed information on device programming and setup.
G. Maintenance Materials: Furnish the following for the District's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
B. Provide five-year manufacturer warranty for all occupancy sensors.
C. Provide five-year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
D. Provide two-year manufacturer warranty for all daylighting controls.

PART 2 - PRODUCTS

2.1 ALL LIGHTING CONTROL DEVICES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
C. Products for Switching of Electronic Fluorescent Ballasts: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

A. Manufacturers:
   1. WattStopper; www.wattstopper.com.
   2. Substitutions: See Section 016000 - Product Requirements.
   3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
B. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
      b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
      c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
      d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.

6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, up to a maximum time delay setting of not less than 15 minutes and not more than 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
11. Compatibility: Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on the drawings.
13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.

C. Wall Switch Occupancy Sensors:
   1. All Wall Switch Occupancy Sensors:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
      b. Unless otherwise indicated or required to control the load indicated on the drawings, provide line voltage units with self-contained relay.
      c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
      d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
      e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
      f. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
      g. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
   2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
   3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet.
   4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:
      a. Description: Low profile occupancy sensors designed for ceiling installation.
      b. Unless otherwise indicated or required to control the load indicated on the drawings, provide low voltage units, for use with separate compatible

accessory power packs.

2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.

E. Directional Occupancy Sensors:
   1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
   2. Passive Infrared (PIR) Directional Occupancy Sensors:
      a. Long Range Sensors: Capable of detecting motion within a distance of 80 feet at a mounting height of 10 feet.
   3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.

F. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.

G. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
   2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on the drawings.
   3. Input Supply Voltage: Dual rated for 120/277 V ac.

H. Accessories:
   1. Provide heavy duty coated steel wire protective guards compatible with specified occupancy sensors where indicated.

2.3 TIME SWITCHES

A. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

B. Electromechanical Time Switches:
1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
2. Program Capability:
3. Schedule Capacity:
4. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
5. Input Supply Voltage: As indicated on the drawings.
6. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

2.4 IN-WALL TIME SWITCHES

A. Digital Electronic In-Wall Time Switches:
1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
3. Schedule Capacity: Not less than 40 programmable on/off operations.
4. Provide power outage backup to retain programming and maintain clock.
5. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
6. Switch Configuration: Suitable for use in either SPST or 3-way application.

B. Electromechanical In-Wall Time Switches:
1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, suitable for mounting in standard wall box, and listed and labeled as complying with UL 917.
2. Program Capability: 24-hour time switch with same schedule for each day of the week.
3. Schedule Capacity: Accommodating not less than 24 selected on/off operations per day.
4. Manual override: Capable of permanently overriding current schedule.
5. Switch Configuration: SPST.

2.5 OUTDOOR PHOTO CONTROLS

A. Stem-Mounted Outdoor Photo Controls:
1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL

773A.
2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.

2.6 DAYLIGHTING CONTROLS

A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.
B. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
   1. Sensor Type: Filtered silicon photo diode.
   2. Sensor Range:
      a. Indoor Photo Sensors: 5 to 100 footcandles.
      b. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
C. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
D. Daylighting Control Switching Modules: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
   1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
   2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
   3. Control Capability:
E. Daylighting Control Dimming Modules: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
   1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
   2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
   3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
   4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
F. Power Packs for Daylighting Control Modules:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for

switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on the drawings.

2. Input Supply Voltage: Dual rated for 120/277 V ac.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
D. Verify that final surface finishes are complete, including painting.
E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1, including mounting heights specified in that standard unless otherwise indicated
B. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
      b. In-Wall Time Switches: 48 inches above finished floor.
      c. In-Wall Interval Timers: 48 inches above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify LP Consulting Engineers to obtain direction prior to proceeding with work.
C. Install lighting control devices in accordance with manufacturer's instructions.
D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
E. Install lighting control devices plumb and level, and held securely in place.
F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
G. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet

boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

H. Occupancy Sensor Locations:
   1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
   2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

I. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

J. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

K. Daylighting Control Photo Sensor Locations:
   1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
   2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
   3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

3.4 FIELD QUALITY CONTROL

A. Inspect each lighting control device for damage and defects.

B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

C. Test time switches to verify proper operation.

D. Test outdoor photo controls to verify proper operation, including time delays where applicable.

E. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

F. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.
B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by LP Consulting Engineers.
C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by LP Consulting Engineers. Record settings in written report to be included with submittals.
F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by LP Consulting Engineers.
G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by LP Consulting Engineers.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

A. See Section 019113 for commissioning requirements.

3.8 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to LP Consulting Engineers, and correct deficiencies or make adjustments as directed.
B. Training: Train District's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of two hours of training.
    3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
    4. Location: At project site.

END OF SECTION 26 09 23

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.
B. Lighting and appliance panelboards.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
B. Section 26 05 53 - Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
B. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2000 (R2005).
C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001 (R2006).
D. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2006.
E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2007.
F. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
G. NFPA 70 - National Electrical Code; National Fire Protection Association, 2017 with 2019 California Electrical Code amendments.

1.4 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
B. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
C. Maintenance Materials: Furnish the following for District (Owner)'s use in maintenance of project.
    1. Panelboard Keys: Two of each different key.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
B. Schneider Electric; Square D Products:
C. Siemens
D. Or equivalent subject to substitution process

2.2 POWER DISTRIBUTION PANELBOARDS

A. Description: NEMA PB 1, circuit breaker type.
B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
C. Minimum integrated short circuit rating: As indicated.
   1. 240 Volt Panelboards: 10,000 amperes rms symmetrical per plan.
   2. 480 Volt Panelboards: 14,000 amperes rms symmetrical per plan.
D. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
E. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay.
   1. Coil operating voltage: 120 volts, 60 Hz.
   2. Size as shown on Drawings.
F. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
G. Enclosure: NEMA PB 1, Type 1, cabinet box.
H. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
C. Minimum Integrated Short Circuit Rating: As indicated.
   1. 240 Volt Panelboards: 10,000 amperes rms symmetrical.
D. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
   1. Type SWD for lighting circuits.
   2. Type HACR for air conditioning equipment circuits.
   3. Class A ground fault interrupter circuit breakers where scheduled.
   4. Do not use tandem circuit breakers.
E. Enclosure: NEMA PB 1, Type 1.
F. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.
G. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.
B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
D. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
F. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
    1. Minimum spare conduits: 5 empty 1 inch.
G. Ground and bond panelboard enclosure according to Section 260526.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing.
B. Inspect and test in accordance with NETA STD ATS, except Section 4.
C. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.3 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 262416

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.
B. Wall dimmers.
C. Fan speed controllers.
D. Receptacles.
E. Wall plates.
F. Floor box service fittings.
G. Poke-through assemblies.

1.2 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260533.16 - Boxes.
C. Section 260553 - Identification for Electrical Systems: Labels for wiring devices.

1.3 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
C. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
E. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
F. NFPA 70 - National Electrical Code; National Fire Protection Association, 2017 with 2019 California Electrical Code amendments.
G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
L. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
    2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify the Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Pass & Seymore
B. Cooper Wiring Devices: www.cooperwiringdevices.com.
C. Leviton Manufacturing, Inc: www.leviton.com.
D. Or equal.

2.2 PROVIDE WIRING DEVICES SUITABLE FOR INTENDED USE AND WITH

RATINGS ADEQUATE FOR LOAD SERVED.

A. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
B. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
C. Provide GFI receptacles for all receptacles installed within 6 feet of sinks.
D. Provide GFI receptacles for all receptacles installed in kitchens.
E. Provide GFI receptacles for all receptacles serving electric drinking fountains.
F. Provide isolated ground receptacles for all receptacles serving computers and electronic cash registers.
G. Unless noted otherwise, do not use combination switch/receptacle devices.
H. For flush floor service fittings, use tile rings for installations in tile floors.

I. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.3 PROVIDE PRODUCTS LISTED AND CLASSIFIED BY UNDERWRITERS LABORATORIES INC. AS SUITABLE FOR THE PURPOSE SPECIFIED AND INDICATED.

A. Finishes:

2.4 ALL WIRING DEVICES: WHITE WITH WHITE NYLON WALL PLATE UNLESS OTHERWISE INDICATED.

A. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate unless otherwise indicated.
B. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate unless otherwise indicated.
C. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover unless otherwise indicated.
D. Isolated Ground Convenience Receptacles: Orange with isolated ground triangle mark on device face.
E. Surge Protection Receptacles: Blue.
F. Clock Hanger Receptacles: White with nylon wall plate.
G. Above-Floor Service Fittings: wiring devices with housing.
H. Flush Floor Box Service Fittings: wiring devices with cover and ring/flange.
I. Flush Poke-Through Service Fittings: wiring devices with cover and aluminum flange.
J. WALL SWITCHES

2.5 ALL WALL SWITCHES: AC ONLY, QUIET OPERATING, GENERAL-USE SNAP SWITCHES WITH SILVER ALLOY CONTACTS, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 20 AND WHERE APPLICABLE, FS W-S-896; TYPES AS INDICATED ON THE DRAWINGS.

2.6 WIRING PROVISIONS: TERMINAL SCREWS FOR SIDE WIRING AND SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW.

2.7 BODY AND HANDLE: WHITE PLASTIC WITH TOGGLE HANDLE.

A. Indicator Light: Lighted handle type switch; red handle.
B. Locator Light: Lighted handle type switch; red color handle.
C. Ratings:
D. Voltage: 120 and 277 volts, AC.

2.8 CURRENT: 20 AMPERES.

2.9 SWITCH TYPES: SINGLE POLE, DOUBLE POLE, AND 3-WAY.

A. WALL DIMMERS

2.10 ALL WALL DIMMERS: SOLID-STATE WITH CONTINUOUS FULL-RANGE EVEN CONTROL FOLLOWING SQUARE LAW DIMMING CURVE, INTEGRAL RADIO FREQUENCY INTERFERENCE FILTERING, POWER FAILURE PRESET MEMORY, AIR GAP SWITCH ACCESSIBLE WITHOUT REMOVING WALL PLATE, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 1472; TYPES AND RATINGS SUITABLE FOR LOAD CONTROLLED AS INDICATED ON THE DRAWINGS.

A. Electronic Low-Voltage Wall Dimmers: 120 V AC, slide control type with separate on/off switch; single pole or three way as indicated on the drawings.

2.11 POWER RATING: 400 VA UNLESS OTHERWISE INDICATED OR REQUIRED TO CONTROL THE LOAD INDICATED ON THE DRAWINGS.

2.12 FLUORESCENT WALL DIMMERS: 120 V AC, SLIDE CONTROL TYPE WITH SEPARATE ON/OFF SWITCH, COMPATIBLE WITH DIMMING BALLAST CONTROLLED; SINGLE POLE OR THREE WAY AS INDICATED ON THE DRAWINGS.

2.13 POWER RATING: 600 VA UNLESS OTHERWISE INDICATED OR REQUIRED TO CONTROL THE LOAD INDICATED ON THE DRAWINGS.

2.14 WALL DIMMERS: SEMICONDUCTOR DIMMER FOR INCANDESCENT LAMPS, TYPE AS INDICATED ON DRAWINGS, COMPLYING WITH NEMA WD 6 AND WD 1.

2.15 BODY AND HANDLE: WHITE PLASTIC WITH ROTARY KNOB.

A. Voltage: 120 and 277 volts.
B. Power Rating: 600 watts.

2.16 PROVIDE ACCESSORY WALL SWITCHES TO MATCH DIMMER APPEARANCE WHEN INSTALLED ADJACENT TO EACH OTHER.

A. FAN SPEED CONTROLLERS

2.17 DESCRIPTION: 120 V AC, SOLID-STATE, FULL-RANGE VARIABLE SPEED, SLIDE CONTROL TYPE WITH SEPARATE ON/OFF SWITCH, WITH INTEGRAL RADIO FREQUENCY INTERFERENCE FILTERING, FAN HUM ELIMINATION CIRCUITRY, FIELD-ADJUSTABLE TRIM, POWER FAILURE PRESET MEMORY, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 1917.

2.18 CURRENT RATING: 1.5 A UNLESS OTHERWISE INDICATED OR REQUIRED TO CONTROL THE LOAD INDICATED ON THE DRAWINGS.

A. RECEPTACLES

2.19 ALL RECEPTACLES: SELF-GROUNDING, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 498, AND WHERE APPLICABLE, FS W-C-596; TYPES AS INDICATED ON THE DRAWINGS.

2.20 WIRING PROVISIONS: TERMINAL SCREWS FOR SIDE WIRING OR SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW.

A. NEMA configurations specified are according to NEMA WD 6.
B. Convenience Receptacles:

2.21 STANDARD CONVENIENCE RECEPTACLES: COMMERCIAL SPECIFICATION GRADE, 20A, 125V, NEMA 5-20R; SINGLE OR DUPLEX AS INDICATED ON THE DRAWINGS.

A. Isolated Ground Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; single or duplex as indicated on the drawings.
B. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

C. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
D. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
E. GFI Receptacles:

2.22 ALL GFI RECEPTACLES: PROVIDE WITH FEED-THROUGH PROTECTION, LIGHT TO INDICATE GROUND FAULT TRIPPED CONDITION AND LOSS OF PROTECTION, AND LIST AS COMPLYING WITH UL 943, CLASS A.

A. Standard GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
B. Weather Resistant GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
C. Tamper Resistant GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
D. Tamper Resistant and Weather Resistant GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.23 RECEPTACLES: HEAVY DUTY, COMPLYING WITH NEMA WD 6 AND WD 1.

A. Device Body: white plastic.

2.24 CONFIGURATION: NEMA WD 6, TYPE AS SPECIFIED AND INDICATED.

A. Convenience Receptacles: Type 5 to 15.

2.25 SINGLE CONVENIENCE RECEPTACLES.

A. Duplex Convenience Receptacles.
B. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
C. TELEPHONE AND DATA JACKS
D. WALL PLATES

2.26 ALL WALL PLATES: COMPLY WITH UL 514D.

2.27 CONFIGURATION: ONE PIECE COVER AS REQUIRED FOR QUANTITY AND TYPES OF CORRESPONDING WIRING DEVICES.

A. Size: Standard; .
B. Screws: Metal with slotted heads finished to match wall plate finish.

2.28 NYLON WALL PLATES: SMOOTH FINISH, HIGH-IMPACT THERMOPLASTIC.

A. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
B. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
C. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected.
E. Decorative Cover Plates: white, nylon.
F. Jumbo Cover Plates: Ivory, nylon.
G. Weatherproof Cover Plates: Gasketed cast metal with hinged.
H. FLOOR BOX SERVICE FITTINGS

2.29 DESCRIPTION: SERVICE FITTINGS COMPATIBLE WITH FLOOR BOXES

PROVIDED UNDER SECTION 260537 WITH ALL COMPONENTS, ADAPTERS,

AND TRIMS REQUIRED FOR COMPLETE INSTALLATION.

A. Above-Floor Service Fittings:
B. Flush Floor Service Fittings:

2.30 SINGLE SERVICE FLUSH CONVENIENCE RECEPTACLES:

A. Cover: Rectangular.

2.31 CONFIGURATION: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S)

WITH DUPLEX FLAP OPENING(S).

A. Single Service Flush Communications Outlets:
    1. Cover: Rectangular.
    2. Configuration: .

2.32 SINGLE SERVICE FLUSH FURNITURE FEED:

2.33 COVER: RECTANGULAR.

2.34 CONFIGURATION: ONE 2-1/8 INCH BY 3/4 INCH COMBINATION THREADED

OPENING(S).

A. Dual Service Flush Combination Outlets:

2.35 COVER: RECTANGULAR.

A. Configuration:

2.36 POWER: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S) WITH DUPLEX FLAP OPENING(S).

A. Communications: .
B. Dual Service Flush Furniture Feed:

2.37 COVER: RECTANGULAR.

A. Configuration:

2.38 POWER: ONE 2-1/8 INCH BY 3/4 INCH COMBINATION THREADED OPENING(S).

A. Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
B. Accessories:

2.39 TILE RINGS: FINISH TO MATCH COVERS; CONFIGURATION AS REQUIRED TO ACCOMMODATE SPECIFIED COVERS.

A. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.
B. Flush Cover Convenience Receptacles:

2.40 MATERIAL: BRASS.

2.41 FLUSH COVER COMMUNICATION OUTLETS:

2.42 FLUSH COVER COMBINATION FITTINGS:

A. Material: Brass.

2.43 PROTECTIVE RING: BRASS FINISH.

2.44 SPLIT NOZZLES: BRASS FINISH.

A. Carpet Rings: Brass.
B. POKE-THROUGH ASSEMBLIES

2.45 DESCRIPTION: ASSEMBLY COMPRISING FLOOR SERVICE FITTING, POKE-THROUGH COMPONENT, FIRE STOPS AND SMOKE BARRIERS, AND JUNCTION BOX FOR CONDUIT TERMINATION; FIRE RATING LISTED TO MATCH FIRE RATING OF FLOOR AND SUITABLE FOR FLOOR THICKNESS WHERE INSTALLED.

A. Above-Floor Service Fittings:
B. Flush Floor Service Fittings:

2.46 SINGLE SERVICE FLUSH CONVENIENCE RECEPTACLES:

2.47 CONFIGURATION: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S) WITH DUPLEX FLAP OPENING(S).

A. Single Service Flush Communications Outlets:
   1. Configuration:

2.48 VOICE AND DATA JACKS: AS SPECIFIED IN SECTION 271005.

A. Single Service Flush Furniture Feed:

2.49 CONFIGURATION: ONE 2 INCH BY 1-1/4 INCH COMBINATION THREADED OPENING(S).

A. Dual Service Flush Combination Outlets:

2.50 COVER: HINGED DOOR(S).

A. Configuration:

2.51 POWER: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S).

A. Communications: ___.
B. Voice and Data Jacks: As specified in Section 271005.
C. Dual Service Flush Furniture Feed:

2.52 CONFIGURATION:

2.53 POWER: ONE 3/4 INCH THREADED OPENING(S).

PART 3 EXECUTION

EXAMINATION

4.1 VERIFY THAT FIELD MEASUREMENTS ARE AS SHOWN ON THE DRAWINGS.

A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
C. Verify that final surface finishes are complete, including painting.
D. Verify that floor boxes are adjusted properly.
E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
F. Verify that core drilled holes for poke-through assemblies are in proper locations.
G. Verify that conditions are satisfactory for installation prior to starting work.
H. PREPARATION

4.2 PROVIDE EXTENSION RINGS TO BRING OUTLET BOXES FLUSH WITH FINISHED SURFACE.

A. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.
B. INSTALLATION

4.3 PERFORM WORK IN A NEAT AND WORKMANLIKE MANNER IN ACCORDANCE WITH NECA 1, INCLUDING MOUNTING HEIGHTS SPECIFIED IN THAT STANDARD UNLESS OTHERWISE INDICATED.

A. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of wiring devices provided under this section.

4.4 MOUNTING HEIGHTS: UNLESS OTHERWISE INDICATED, AS FOLLOWS:

4.5 WALL SWITCHES: 48 INCHES ABOVE FINISHED FLOOR.

A. Wall Dimmers: 48 inches above finished floor.
B. Fan Speed Controllers: 48 inches above finished floor.
C. Receptacles: 18 inches above finished floor or 6 inches above counter.

4.6 ORIENT OUTLET BOXES FOR VERTICAL INSTALLATION OF WIRING DEVICES UNLESS OTHERWISE INDICATED.

A. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
B. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify LP Consulting Engineers to obtain direction prior to proceeding with work.
C. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

4.7 INSTALL WIRING DEVICES IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

A. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
B. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
C. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
D. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
E. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding

conductor.

F. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
G. Install wiring devices plumb and level with mounting yoke held rigidly in place.
H. Install wall switches with OFF position down.
I. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
J. Do not share neutral conductor on branch circuits utilizing wall dimmers.
K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
N. Install identification label for wall switches and wall dimmers in accordance with Section 260526 indicating load served when controlling loads that are not visible from the control location or multiple wall switches or wall dimmers are installed at one location.
O. Install identification label for all receptacles in accordance with Section 260526 indicating serving branch circuit.
P. Install poke-through closure plugs in all unused core holes to maintain fire rating of floor.
Q. Install receptacles with grounding pole on top.
R. Connect wiring device grounding terminal to outlet box with bonding jumper.
S. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
T. Connect wiring devices by wrapping conductor around screw terminal.
U. Use jumbo size plates for outlets installed in masonry walls.
V. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
W. Install protective rings on active flush cover service fittings.
X. INTERFACE WITH OTHER PRODUCTS

4.8 COORDINATE LOCATIONS OF OUTLET BOXES PROVIDED UNDER SECTION 260537 TO OBTAIN MOUNTING HEIGHTS SPECIFIED.

A. Install wall switch 48 inches above finished floor.
B. Install convenience receptacle 18 inches above finished floor.
C. Install convenience receptacle 6 inches above counter.
D. Install dimmer 48 inches above finished floor.
E. Install telephone jack 18 inches above finished floor.
F. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.
G. Coordinate installation of access floor boxes with access floor system provided under Section 096900.
H. FIELD QUALITY CONTROL

4.9 ADJUST DEVICES AND WALL PLATES TO BE FLUSH AND LEVEL.

A. CLEANING

4.10 CLEAN EXPOSED SURFACES TO REMOVE DIRT, PAINT, OR OTHER FOREIGN MATERIAL AND RESTORE TO MATCH ORIGINAL FACTORY FINISH.

END OF SECTION 262726

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.
B. Spare fuse cabinet.

1.2 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.
B. NFPA 70 - National Electrical Code; National Fire Protection Association, 2017 with 2019 California Electrical Code amendments.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data sheets showing electrical characteristics, including time-current curves.
C. Maintenance Materials: Furnish the following for the District's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.
    2. Extra Fuses: Three of each type and size.

1.4 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cooper Bussmann
B. Ferraz Shawmut, Inc
C. Littelfuse
D. Or approved Equal

2.2 FUSES - GENERAL

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
B. Voltage: Rating suitable for circuit phase-to-phase voltage.
C. Main Service Switches Larger than 600 amperes: Class L (time delay).
D. Main Service Switches: Class RK1 (time delay).
E. Power Load Feeder Switches: Class RK1 (time delay).

F. Motor Load Feeder Switches: Class RK1 (time delay).
G. Lighting Load Feeder Switches: Class RK1 (time delay).
H. Other Feeder Switches: Class RK1 (time delay).
I. General Purpose Branch Circuits: Class RK1 (time delay).
J. Motor Branch Circuits: Class L time delay.

2.3 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
B. Doors: Hinged, with hasp for the District's padlock.

PART 3 - EXECUTION

3.1 INSTALLATION0

A. Install fuses with label oriented such that manufacturer, type, and size are easily read.
B. Install spare fuse cabinet where indicated.

END OF SECTION 26 28 13

SECTION 26 28 16

DISCONNECTS

PART 1 – GENERAL

1.1 FURNISH AND INSTALL ALL DISCONNECT SWITCHES AS SHOWN ON THE DRAWINGS AND AS REQUIRED BY THE CEC.

1.2 SUBMIT MANUFACTURERS' DATA FOR ALL DISCONNECTS AND FUSES.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS SHALL BE SQUARE D, CUTLER HAMMER OR SIEMENS.

2.2 EQUIPMENT MANUFACTURED BY GENERAL ELECTRIC, AND/OR ANY OTHER MANUFACTURERS NOT SPECIFICALLY LISTED IN SECTION 2.1 ARE NOT CONSIDERED EQUAL, OR APPROVED FOR USE ON THIS PROJECT.

2.3 ALL SWITCHES SHALL BE HEAVY-DUTY TYPE, EXTERNALLY OPERATED, QUICK-MAKE, QUICK-BREAK, RATED 600 VOLTS OR 240 VOLTS AS REQUIRED, WITH THE NUMBER OF POLES AND AMPACITY AS NOTED. ALL SWITCHES FOR MOTORS SHALL BE HP RATED. SWITCHES SHALL HAVE NEMA-TYPE 1 ENCLOSURES, EXCEPT SWITCHES LOCATED WHERE EXPOSED TO OUTDOOR CONDITIONS SHALL HAVE NEMA TYPE 3R ENCLOSURE. SWITCHES GENERALLY SHALL BE FUSED EXCEPT WHERE NOTED TO BE NON-FUSED ON THE DRAWINGS.

2.4 WHERE FUSES ARE INDICATED, FUSES SHALL BE BUSSMAN OR LITTLEFUSE (NO KNOWN EQUAL). FUSES SHALL BE CURRENT LIMITING TYPE WITH TIME DELAY CHARACTERISTICS TO SUIT THE EQUIPMENT SERVED.

PART 3 – EXECUTION

3.1 MOUNT ALL SWITCHES TO STRUCTURE OR U-CHANNEL SUPPORT. U-CHANNEL SUPPORTS SHALL BE CLEANED AND PAINTED TO PREVENT RUST.

3.2 SWITCHES SHALL BE ACCESSIBLE WITH PROPER CLEARANCES IN FRONT PER CEC 110-16.

3.3 ALL LUGS SHALL BE TORQUE TESTED IN THE PRESENCE OF THE INSPECTOR OF RECORD.

3.4 ARC FLASH AND SHOCK HAZARD

A. The contractor is to provide, and submit to the engineer for approval, incident energy level calculations as determined using the methodologies described in NFPA 70E or IEEE standard 1584-2002.
B. A warning label, as specified in the above standard, shall be placed on each switchboard, panelboard, and safety switch indicating the incident energy levels on the equipment to warn qualified personnel in accordance with NFPA 70E, section 400.11. Labels shall be laminated white micarta with black lettering on each. Letters shall be no less than 3/8" high.
C. The incident level calculations for each piece of equipment shall be given to the owner and maintained on file by the maintenance department.
D. The design goal is to minimize the incident energy to which a maintenance employee may be exposed and in no case more than 8 cal./cm².

END OF SECTION 26 28 16

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires.
B. Exit signs.
C. Lamps.
D. Luminaire accessories.

1.2 RELATED REQUIREMENTS

A. Section 260533.13 - Boxes.
B. Section 260923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
C. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

1.3 REFERENCE STANDARDS

A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 2006.
B. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 2002.
C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (R2008).
D. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002.
E. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
F. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
G. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
H. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; National Electrical Manufacturers Association; 2006.
I. NFPA 70 - National Electrical Code; National Fire Protection Association 2017 with amendments from the 2019 California Electrical Code (CEC).
J. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2009.
K. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
L. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
M. UL 1598 - Luminaires; Current Edition, Including All Revisions.
N. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify the Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Provide photometric calculations where luminaires are proposed for substitution upon request.
B. Shop Drawings: Indicate dimensions and components for each fixture that is not a standard product of the manufacturer.
C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
G. Maintenance Materials: Furnish the following for District's use in maintenance of project.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Conform to requirements of NFPA 70 and NFPA 101.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Furnish products as indicated in Lighting Fixture Schedule included on the Drawings

2.2 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule on the drawings.
B. Or equal in performance and quality acceptable by the Architect and/or the District Representative.

2.3 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.
B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
C. Provide products that comply with requirements of NFPA 70 and NFPA 101.
D. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
H. Recessed Luminaires:
    1. Ceiling Compatibility: Comply with NEMA LE 4.
    2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
    3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
I. LED Luminaires: Listed and labeled as complying with UL 8750.

2.4 LUMINAIRES

A. Furnish products as indicated in Lighting Fixture Schedule included on the Drawings.

2.5 EXIT SIGNS

A. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single or double as indicated or as required for the installed location.
   2. Directional Arrows: As indicated or as required for the installed location.
B. Accessories:
   1. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
   2. Provide compatible accessory wire guards where indicated.
C. Manufacturers: Furnish products as indicated in Lighting Fixture Schedule included on the Drawings
D. Exit Signs: Exit sign fixture suitable for use as emergency lighting unit.
   1. Provide fixtures complying with NFPA 101.
   2. Directional Arrows: Universal type for field adjustment.
   3. Mounting: As indicated.
   4. Battery: 6 or 12 volt, nickel-cadmium type, with 1.5 hour capacity.
   5. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
   6. Lamps: Manufacturer's standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of luminaires provided under this section.
B. Install products according to manufacturer's instructions.
C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).
D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
E. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
F. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
G. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
H. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
I. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
J. Exposed Grid Ceilings: Support surface mounted luminaires in grid ceiling directly from building structure.
K. Install recessed luminaires to permit removal from below.
L. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
M. Install clips to secure recessed grid-supported luminaires in place.

N. Install wall mounted luminaires and exit signs at height as indicated on Drawings.
O. Install accessories furnished with each luminaire.
P. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.
Q. Connect luminaires and exit signs to branch circuit outlets provided under Section 260537 using flexible conduit.
R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
S. Bond products and metal accessories to branch circuit equipment grounding conductor.
T. Install specified lamps in each exit sign and luminaire.
U. Exit Signs:
V. Install lamps in each luminaire.
W. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.2 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.
B. Inspect each product for damage and defects.
C. Perform field inspection in accordance with Section 014000.
D. Operate each luminaire after installation and connection to verify proper operation.
E. Test self-powered exit signs, emergency lighting units, and emergency power supply units to verify proper operation upon loss of normal power supply.
F. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by LP Consulting Engineers.

3.3 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by LP Consulting Engineers. Secure locking fittings in place.
B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by LP Consulting Engineers or authority having jurisdiction.
C. Aim and adjust fixtures as indicated.
D. Position exit sign directional arrows as indicated.

3.4 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosures.
D. Clean finishes and touch up damage.

3.5 PROTECTION

A. Re-lamp luminaires that have failed lamps at Substantial Completion.

3.6 SCHEDULE - SEE DRAWINGS

END OF SECTION 26 51 00

SECTION 26 52 00

LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Provide all labor, materials, equipment and incidentals required and install complete ready for operation and field test a lighting control system as detailed by plans and specifications. The system shall include as a complete package all lighting control panels, relays, switches, switch panels, and other devices required for a fully operational lighting control system.

1.2 QUALITY ASSURANCE

A. The system shall be supplied by a lighting control system manufacturer with at least five years experience in the lighting control industry.
B. Control panels shall be factory assembled and UL listed under the UL 508 standard.
C. Products must be certified by the California Energy Commission for compliance under Title 24.

1.3 SUBMITTALS

A. Manufacturer's data sheets shall consists of specifications, written instruction, and engineering data printed and provided by the manufacturer of the specified item and provide complete descriptive information.
B. Shop drawings shall consist of power and control wiring diagrams, plans, with elevations, sections, and details.

PART 2 - PRODUCTS

2.1 PERFORMANCE

A. The control system shall be pre-assembled, designed and manufactured specific for the facility to operate the lighting as follows:
    1. Lighting shall be controlled by individually controlled zones:
        a. Interior lighting shut-off: Two-hour lighting shut-off
        b. Exterior lighting: Photocell on, time off.
        c. Exterior security lighting: Photocell on, photocell off
        d. Emergency lighting: Continuous operation.
    2. During the time when the facility is to be un-occupied, interior light zones shall automatically shut off. During the un-occupied period, any override of the interior lighting shall be limited to a maximum of two hours per California Title 24 standards.
    3. All exterior light controls shall be interlocked to operate with an adjustable exterior photocell.

2.2 LIGHTING CONTROL PANELS

A. Acceptable products shall be Watt-Stopper, or accepted equal upon prior request for substitution for District consideration approval.

B. All lighting controls shall be pre-assembled, wired, and tested to operate as a complete integral system and shall provide the lighting control features specified in this section.
C. The main lighting control panel shall have a hinged lockable door and contain all necessary hardware (transformers, relays, timers, fuses, switches, terminals etc.,) to control and/or connect to the lighting circuits specified for control. Unit shall be shipped factory assembled with automatic time switch, control panel, and internal components installed, wired and tested in the enclosure. Barriers shall divide high voltage and class two compartments.
    1. Automatic time switch shall be astronomic solid state, 365-day control. The time switch shall have holiday scheduling, each programmable by date, automatic daylight savings, leap year adjustments, and battery backup of up to 72 hours.
    2. All power sources and transformers interior to the lighting control panel shall be independently fused. Spare fuses shall be included.
    3. The lighting control panel shall have terminals providing the capability to tie in wiring to/from expansion control panels that may be installed remote from the main lighting control panel. The main panel shall provide low voltage (class 2) control outputs signals for controlling expansion control panel.
    4. All termination points shall be captive screw type, no wire lugging shall be required. Each termination point and control component shall be clearly labeled for easy field identification.
    5. The lighting control panel shall provide termination points for connecting a low voltage photocell for interlocking control of exterior lighting.
    6. An extended occupancy switch shall be provided to allow extension of the occupancy schedule without re-programming of the time switch only for specified lighting control zones. This extended occupancy shall be configurable from one to twelve hours.
    7. Where on/off control switches are not available to operate lighting levels, override switches shall be installed in the lighting control panel door to operate these lighting levels. Override switches shall allow operation of lighting levels either on or off until the next programmed event. Override switch operation shall not depend on the operation of a time switch or other controller, but shall be hard wired, providing reliable operation of the lighting control zone. All switches shall be marked to indicate the light level for which they control. Panel mounted override switches shall be illuminated to annunciate the state of the lighting control level for which they control.
    8. Two prints, specific for each lighting control panel, shall be provided in a clear print pocket mounted in the door. The print shall be specific indicating termination point of each lighting circuit controlled by number and panel name. Prints shall indicate location and lighting control level assigned to each lighting contactor.
D. The lighting control panel shall be able to house and control multi-pole contactors for the operation of multi-circuit or multi-phase loads. The multi-pole contactors shall be electrically held and lighting rated for 20 amperes on a tungsten or ballast load. Contactors shall be compact, rail mount style for easy removal and service. System and switch logic controlling contactors shall be configurable and rated Class 2.
E. Expansion control panels shall expand the control of the main lighting control panel by accepting control signals from the main lighting control panel to operate remote lighting / load circuits. Expansion lighting control panels shall provide all Class 2, transformer relay and multi-pole contactor control functions as the main lighting control panel.

2.3 PHOTOCELL

A. Low voltage photocell shall operate off of 24VAC and be compatible with the lighting control panel.
B. Adjustable aperture with on/off delay feature to eliminate nuisance cycling.

2.4 AUTOMATIC SHUT-OFF SWITCH CONTROL

A. The lighting control panel shall have the capability to signal Automatic Shut-off Switches to shut lighting off when commanded. All timing sequences required to perform the shut-off shall be part of the control panel system.
B. Operation of the automatic shut-off shall be via multi-pole, electrically held contactors rated for 20 Amp tungsten. Contactors shall be normally closed and be able to operate all switches connected to the circuits during an automatic shut-off.
C. Expansion control panels shall expand the control of the main lighting control panel by accepting control signals from the main lighting control panel to operate remote lighting circuits.
D. The automatic shut-off switch shall mount in a standard single or multi-gang wall box and shalls utilize standard switch plate covers.

PART 3 - EXECUTION

3.1 START-UP, SUPPORT AND WARRANTY

A. Lighting control system manufacturer shall provide reasonable technical phone assistance to the contractor during installation of the lighting control system and the District Representative.
B. Provide a single site visit, factory system start-up, checkout, and initial programming to assure proper installation and operation of the lighting control system. Factory shall be given at least two weeks notification to schedule checkout visit.
C. Lighting control system shall be factory warranted for one year from defect in material or workmanship, provided the defect develops under normal and proper use.
D. Three complete sets of maintenance instructions, system/component data sheets and operating instructions shall be bound into three ring binders permanently labeled “Lighting Control System” and delivered to the Architect/District.
    1. Preface the Systems manuals with a typewritten sheet in a plastic protector identifying the system installer by business name, address and telephone number.
    2. The manuals shall include all approved submittal information, product data sheets, spare parts list, trouble shooting guides and complete “as-built” drawings. Provide an index to all material and indexing dividers for easy location of information.

3.2 INSTALLATION

A. Lighting control panels shall be flush mounted or as noted on plans. Panel knockout pattern or knockout punches shall be used for conduit entrances. Drilling into the enclosure shall not be permitted. Refer to the electrical drawings for the proper placement of lighting control panels and switches.
B. Provide a 120V control power circuit to each lighting control panel. Power and ground wiring to panels shall be terminated before connecting line and load circuits.
C. Panels controlling fixtures designated “EM” or use for emergency egress shall be powered by the specified emergency power source from an un-switched normally “on” (closed contact) circuit.

D. Installer shall check all wiring to lighting fixtures or other electrical loads for short circuits prior to terminating line and load wiring in the lighting control panel. Line and load wiring shall be terminated directly to lighting contactors for the lighting zone assigned.

E.

Provide, install and terminate any interconnecting wiring between main control panels, expansion panels, photocells, switches and other interconnecting devices. Line voltage and class 2 (low voltage) wiring shall be installed in their respective sections of the panels without cross over.

END OF SECTION 26 52 00

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires.
B. Lamps.
C. Luminaire accessories.

1.2 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260537 - Boxes.
C. Section 260923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.

1.3 REFERENCE STANDARDS

A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns
B. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)
C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
D. IEEE C2 - National Electrical Safety Code
E. IESNA LM-5 - Photometric Measurements of Area and Sports Lighting Installations
F. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information
G. IESNA LM-64 - Photometric Measurements of Parking Areas
H. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association
I. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems
J. NFPA 70 - National Electrical Code; National Fire Protection Association, 2017 with California amendments, CEC 2019.
K. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
L. UL 1598 - Luminaires; Current Edition, Including All Revisions.
M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Notify the Architect and/or the District Representative of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Coordination: Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
   1. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
   2. Lamps: Include rated life and initial and mean lumen output.
C. Field Quality Control Reports.
   1. Include test report indicating measured illumination levels.
D. Test Reports: Indicate measured illumination levels.
E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
G. Maintenance Materials: Furnish the following for District's use in maintenance of project.
H. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
D. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 - PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the Drawings.

2.2 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.
B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
H. LED Luminaires: Listed and labeled as complying with UL 8750.

2.3 LAMPS

A. Manufacturers:
    1. General Electric Company/GE Lighting; www.gelighting.com.
    2. Osram Sylvania; www.sylvania.com.
    3. Philips Lighting Company; www.lighting.philips.com.
    4. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
    5. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
B. All Lamps:
    1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
    2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
    3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
    4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the LP Consulting Engineers to be inconsistent in perceived color temperature.
C. Lamp Types: As specified for each luminaire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
C. Verify that suitable support frames are installed where required.
D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of luminaires provided under this section.
B. Install products according to manufacturer's instructions.
C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
E. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
F. Pole-Mounted Luminaires:
    1. Maintain the following minimum clearances:
        a. Comply with IEEE C2.
        b. Comply with utility company requirements.
    2. Grounding:
        a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
    3. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
G. Install accessories furnished with each luminaire.
H. Bond products and metal accessories to branch circuit equipment grounding conductor.
I. Install lamps in each luminaire.
J. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.3 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.
B. Perform field inspection, testing, and adjusting in accordance with Section 014000.
C. Operate each luminaire after installation and connection to verify proper operation.
D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by LP Consulting Engineers.
E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.
    1. Test according to IESNA LM-64 (parking areas).

F. Measure illumination levels to verify conformance with performance requirements. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by LP Consulting Engineers. Secure locking fittings in place.
B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by LP Consulting Engineers.

3.5 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosure.
D. Clean finishes and touch up damage.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to the Architect and/or District Representative, and correct deficiencies or make adjustments as directed.
B. Just prior to Substantial Completion, replace all lamps that have failed.

3.7 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

3.8 SCHEDULE - SEE DRAWINGS

END OF SECTION 26 56 00

SECTION 27 00 00 - COMMUNICATIONS ADMINISTRATION

PART 1 GENERAL

1.01 SUMMARY

A. The work outlined in this specification section is the general administrative overview for all communications systems installed under Division 27 and Division 28.

1.02 SCOPE

A. Submittals

B. Contractor Installation Shop Drawings

C. Warranty, Testing, and Commissioning

D. Contractor Record Closeout Documents

1.03 RELATED REQUIREMENTS

A. Division 27, Communications

1. Division 27 05 00 – Common Work Results for Communications
2. Division 27 11 00 – Communications Equipment Rooms and Enclosures
3. Division 27 11 23 – Communications Cable Management and Ladder Rack
4. Division 27 13 00 – Communications Backbone Cabling
5. Division 27 15 00 – Communications Horizontal Cabling
6. Division 27 16 00 – Communications Connecting Cords
7. Division 27 51 23 – Intercommunications Program Systems
8. Division 27 53 13 - Clocks
9. Division 28 20 00 – Video Surveillance
10. Division 28 31 00 – Intrusion Detection

1.04 CODES AND STANDARDS

A. The installed system shall confirm to all California State Codes

1. 2022 California Building Code (CBC)
2. 2022 California Electrical Code (CEC)
3. 2022 California Fire Code (CFC)
4. All equipment connected to the Fire Alarm system shall have California State Fire Marshall listing(s).

B. National Codes
   1. 2022 NFPA 70 – National Electrical Code
   2. 2022 NFPA 72 – National Fire Alarm Code
   3. 2022 NFPA 101 – Life Safety Code
   4. Americans with Disabilities Act (ADA)
   5. Local building codes

C. All requirements by the authority having jurisdiction (AHJ)

D. Telecommunications Industry Association Standards (TIA)
   1. TIA 526-7: Single Mode Fiber Standards
   2. TIA 526-17: Multi Mode Fiber Standards
   3. TIA-568-D.1: Commercial Building Telecommunications Cabling Standards.
   4. TIA-568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
   5. TIA-569-E: Telecommunications Pathways and Spaces.
   6. TIA-606-C: Administration Standard for Telecommunications Infrastructure.
   7. TIA-607-D: Generic Telecommunications Bonding and Grounding (Earthing) Requirements for Customer Premises.

E. Audio-Visual and Integrated Experience Association (AVIXA)
   1. A102.01.2017: Audio Coverage Uniformity in Listener Areas (ACU)
   2. 10:2013 Audio-Visual System Performance Verification
   3. F501.01:2015: Cable Labeling for Audio-Visual Systems
   4. V201.01: Projected Image System Contrast Ratio
   5. F502.02:2018: Rack Building for Audio-Visual Systems
   6. A103.01: Sound System Spectral Balance
   7. A104.01: Sound System Dynamic Range

PART 2 PRODUCTS

2.01 N/A

PART 3 EXECUTION

3.01 SUBITTALS

A. Products Material Submittal:
   1. Product data and manufacturer’s installation instructions for information, communications, and technology systems electronically in PDF and XLS format, as required. The PDF shall include bookmarks for each section of the submittal.
   2. A Microsoft Excel spreadsheet listing each item submitted as a separate row. The spreadsheet shall, at a minimum, contain the following columns:
      a. Submittal #,
      b. Item # (tied to PDF cut sheet)
      c. Spec section submitted

d. Drawing sheet referenced
e. Manufacturer
f. Part number
g. Description

B. Products Material substitutions

1. If the Contractor desires to use any other brand or manufacturer of equal quality and utility to that specified, they shall make application to the Owner/Architect/Engineer in writing, and shall submit samples, if requested. Such application constitutes a recommendation that the Contractor:
   a. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.
   b. Will provide the same warranty for equal as for specified product.
   c. Will coordinate installation and make other changes, which may be required for work to be complete in all respects.
   d. Waives claims for additional costs, which may subsequently become apparent.
   e. The Architect/Designer/Engineer will determine whether or not the proposed material is equal in quality and utility to the material specified, and their decision shall be final.
   f. Requests for equal materials will only be considered when offered by the Contractor as required by this section

C. Whenever in the Contract Documents any materials, products, processes, or articles are indicated or specified by the name brand of the manufacturer, or by patent or proprietary names, such specifications shall be deemed to be a measure of quality and utility or a standard and shall be deemed to be followed by the words, “or equal.” It is the intent of this article to comply with Public Contract Code Section 3400.

3.02 CONTRACTOR INSTALLATION SHOP DRAWINGS

A. Contractor installation “Shop Drawings” requirements

1. The Contractor Installation Shop Drawings represent the level of system design to be provided to the Owner/Architect/Engineer. Contractor shall provide all additional system design work required, including:
   a. Conduit layout and sizing.
   b. Wire and cable layout and sizing.
   c. Point-to-point wiring and equipment hook-up information.
   d. Equipment mounting details.
      i. Design of equipment cabinets, including front rack elevations with accurate equipment rack unit spacing and equipment schedules.
      ii. MDF / IDF room wall elevations for all systems, junction boxes, wall mounted equipment, power outlets etc., mounted on each wall.
      iii. MDF / IDF room top view to show placement of equipment racks or cabinets, including required 36” clearance from mounted equipment.
   e. Other detailed design work required.
   f. Contractor’s design shall conform to all applicable codes and ordinances. All electrical design, including the sizing and placement of conduit, raceways and conductors, shall be in accordance with NFPA 70: National Electrical Code, current version, unless local codes establish more stringent requirements.
   g. Contractor’s design work is subject to review and approval by the Owner/Architect/Engineer,

Project Construction Manager.

2. It shall be understood that the drawings, details, and one-lines provided with the design package are diagrammatic and/or performance based. Data presented on design drawings are as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification, of all dimensions, routing, etc., by the contractor is required.
3. Drawings are provided to show the intent of the design and specification and to assist the contractor in submitting a bid. Contractor is directed to make field surveys as part of his work prior to submitting systems installation shop drawings. The contractor shall make allowance in the proposal to cover whatever work is required to comply with the intent of the design and provide a fully functioning complete, operable, and integrated system.
4. In case of doubt of work intended, it is the responsibility of the Contractor to request instructions from the Owner/Architect/Engineer prior to bid. The contractor shall be responsible for installing a complete, operable, integrated and functioning system to the Owners satisfaction.
5. Installation of the systems shall not be started until detailed contractor furnished shop drawings (in AutoCAD 2020 or similar professional drawing format) and product submittals have been approved by the designer and/or architect and if (a. Applicable, approved by the Division of the State Architect).
6. Any and all design and/or installation discrepancies, change orders, (including labor, materials, and shipping) incurred without contractor shop drawings or after contractor shop drawings have been approved shall be the sole responsibility of the contractor.
7. Any work performed without approved contractor furnished shop drawings and submittals shall not be allowed. If work performed prior to approve shop drawings, contractor will do so at their own risk.

3.03 WARRANTY, TESTING, AND COMMISSIONING

A. Warranty:
   1. All components, parts, and installation supplied by the contractor shall be guaranteed against defects in materials and workmanship for one (1) year from date of Notice of Completion or system acceptance, whichever falls later. Labor to repair, reprogram, or replace components shall be furnished by the contractor at no charge during the warranty period.
   2. All warranty work of a minor nature shall be performed during hours when site and/or buildings are not occupied, Monday through Friday. Major warranty work, defined as, affecting more than 15% of the system, causing complete operator workstation or server failure, or work involving life safety shall be responded to within four (4) hours. Major warranty work shall be performed regardless of normal work hours or days until corrected.
   3. All fiber optic data installs shall carry a Limited Lifetime warranty. This will require the contractor to certify their installers to the manufactures guidelines and submit their certifications with bid documents for the project.
   4. Copper (Cat6/Cat6A) network cabling installs for this project shall carry a Limited Lifetime warranty. This will require the contractor to certify their installers to the manufactures guidelines and submit their certifications with bid documents for the project.

3.04 CONTRACTOR RECORD CLOSEOUT DOCUMENTS

A. The Contractor shall provide, at the completion of the project, Project Record Documents and furnish to the Owner one (1) Electronic Copy set of record drawings. The Contractor Record Closeout Documents shall be prepared in such a manner that each ASI, RFI, CCD, PCO is noted and clouded on the Contractor Record Closeout Documents.

B. The Contractor shall provide an electronic copy of the field redline drawings in PDF format.

C. The electronic Contractor Record Closeout Documents shall follow the following standards:

1. Delivered as an electronic set of documents on a CD-R or a memory stick clearly labeled with Job Number, Bid Number and Name of Project.
2. Drawing standards, such as line-types, line-weights, fonts and symbols shall be consistent with the bid set documents.
3. Include text “Record Drawing” or “As Built” on all sheets.
4. Include all revision deltas and clouds on all sheets.
5. AutoCAD files shall adhere to the following standards:
    a. Full drawing package in AutoCAD (AutoCAD 2020 or most current version), executable .dwg format
    b. Include all fonts and plotting line-weights
    c. Include all cross references

D. The Contractor shall prepare and provide a complete Electronic Cable Book (PDF format), submitted on CD or electronically, as documentation. This cable book shall consist of the following with each section bookmarked within the PDF file:

1. Title of project
2. Index page detailing the sections
3. Site plans (Record set redlined drawings on original full-size bid set plans, hard and soft copy)
4. The drawings shall depict, at a minimum, the following conditions:
    a. Division 27 systems as applicable

E. Final inspection will not be made until drawings are received and approved. Record Drawings shall include “As-Built” one-line and wiring diagrams, with terminations identified, wire color coding schedule, pull box locations, and conduit routing plans.

F. Warranty certificates and documentation.

1. One (1) Year workmanship warranty
2. Limited Lifetime manufacturer warranty for Fiber Optic plant.
3. Limited Lifetime manufacturer warranty for Cat6/Cat6A copper plant.

END OF 27 00 00

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. The work of this Section consists of basic materials and methods for all communications, technology, security, access control pathways work included under Division 27 and Division 28. Additional specification requirements for electrical work are specified under other sections of Division 26 and where those requirements differ from the requirements of this section, the more stringent shall govern.

1.03 RELATED REQUIREMENTS

A. Division 01 00 00 specifications, General Requirements
B. Division 26 specification sections, as applicable
C. Division 27 specification sections, as applicable
D. Division 28 specification sections, as applicable

1.04 CODES AND STANDARDS

A. See specification section 27 00 00 for requirements

PART 2 PRODUCTS

2.01 GENERAL

A. All products used on this project shall bear the label and be approved by Underwriters Laboratories "UL" unless otherwise approved in writing by the Owner/Architect/Engineer.
B. Any modification that voids the equipment's UL listing is strictly prohibited (i.e. relocated or oversize knock-outs).
C. Any modified new equipment that voids the UL listing shall be replaced by the Contactor (parts and labor) at their expense.
D. All products shall be new and unused and shall be of manufacturer's current and standard production.
E. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
F. Drawings and specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
G. Product Availability:
   1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
   2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.
   3. Equipment shortages, all equipment and material shall be ordered upon Owner/Architect/Engineer and design professional approval of product submittals and contractor shop drawings. The contractor shall immediately notify the Owner/Architect/Engineer of any long lead or backordered items so an alternate substitution may be reviewed for approval prior to ordering.

2.01 RACEWAYS

A. Rigid Steel Metallic (GRC): Full weight with threaded fittings conforming to industry standards. Rigid steel conduit in contact with earth or in concrete slabs must be PVC wrapped.
   1. Rigid Steel Conduit: Protected inside and outside by galvanizing or sherardizing. By Triangle, Western Pipe & Tubing, Republic or approved equal. Risers and 90-degree elbows shall be wrapped with 3M Scotchwrap 51 PVC-based tape and 3M pipe primer (cover exposed threads and couplings).

B. Electric metallic tubing (EMT): Protected inside and outside by galvanizing or sherardizing. Minimum diameter size for EMT is ¾" and maximum diameter is 4". Same manufacturers as for rigid steel conduit. All fittings by: Thomas & Betts, Steel City, Raco, OZ/Gedney, or approved equal.

C. Flexible conduit: All Flex, American Flexible Conduit, or approved equal. Where exposed to weather use liquid-tight flexible conduit, type UA complete with waterproof fittings. American Flexible Conduit, Electri-Flex, Sealtite, Anaconda, or approved equal.

D. PVC conduit: Schedule 40 polyvinyl chloride high density, high impact, type two with factory-made bends, couplings and fittings, as manufactured by Carlon, PW Pipe, Cantex, or approved equal. Use of PVC is subject to local utility company having jurisdiction.

E. Raceway Fittings:
   1. Rigid Steel Conduit (GRC): Fittings, such as couplings, connectors, conduit bodies, elbows, bends, etc., shall be subject to same requirements as for rigid steel conduit. Couplings and unions shall be threaded type, assembled with anti-corrosion, conductive anti-seize compound at joints, and made absolutely tight to exclude water. Unions shall be equal to Crouse-Hinds UNY, UNF or approved equal.
   2. EMT: Fittings for indoor use: couplings and connectors 3/4" and larger shall be steel setscrew type or threaded compression type. 3/4" and larger, and all outdoor applications shall be compression type. All connectors must have insulated throats.
   3. Flexible Metallic Conduit: Angle wedge type with insulated throat.
   4. Bushings: Metallic insulated type. Weatherproof, liquid-tight, dust-tight installations with sealing ring and insulated throat, Crouse-Hinds, OZ/Gedney type "KR".
   5. Expansion and Deflection Fittings: OZ/Gedney, Type "DX" or accepted equal.

F. All multi-channel non-metallic surface mounted raceways shall be three compartment 5500 Wiremold by Legrand or approved equal - color to be ivory or as selected by the Owner/Architect/Engineer. Provide all components necessary to complete the work.
   1. 5500WC- Wire Clip to be installed every 24"

G. All small single or dual channel non-metallic surface mounted raceways shall be 2300 Wiremold by Legrand, type and size specified in the drawings or approved equal - color to be ivory or as selected by the Owner/Architect/Engineer. Provide all components necessary to complete the work.
   1. Components include, but are not limited to:
      a. Base
      b. Cover
      c. Surface mount box
      d. Tee fitting
      e. 90 flat elbow, inside, outside fittings
      f. Entrance End Fitting
      g. Blank End Fitting
      h. Transition Fitting
      i. Cross-over Fitting
      j. Wire Clip to be installed every 24"

2.02 BOXES

A. Galvanized one-piece or welded pressed steel type. Boxes for fixture shall not be less than 4" square and shall be equipped with fixture stud. Boxes shall be at least 2-1/8" deep, 4" square for 1 or 2 gang devices, with plaster rings and gang box with gang cover. Boxes mounted in wall or ceiling finished with gypsum board shall be furnished with plaster rings. Use screws and not nails to support outlet boxes. Boxes in unfinished areas, installed exposed, shall be cast metal type for switches and convenience outlets. Provide blank cover for all boxes without fixture or device.

B. Interior Junction boxes, larger than 8” square, located indoors shall be NEMA rated, with hinged door and an Allen key type lock kit.
C. Exterior Junction boxes, larger than 8” square, located outdoors, or in wet or damp locations shall be rated NEMA-3R, with hinged door and cylinder lock kit keyed to match the site’s master key.
D. Floor boxes shall be one-gang or multi-gang recessed, fully adjustable with lids and cover plates for respective tile or carpet floor finish. For "hard" floors such as tile or wood, the top of the cover shall be flush with the top of the finished floor. Receptacle covers shall have individual flip-lids with screw lock. Junction boxes shall have screwed on plugs.
   1. Grade level or below: Watertight and concrete-tight of cast iron construction, FSR FL series, Walker 880CS series or equal.
   2. Above grade level: Concrete-tight of stamped steel construction, FSR FL series, Walker 880S series or equal.
E. Provide and install center pin Torx tamper-proof screws for all exterior boxes and conduit bodies (i.e. LB, SLB, RLB, etc.).

2.03 PULL LINE

A. Furnish and install pull line in all new unused (empty) raceways / conduits.
B. Furnish and install replacement pull lines in all raceways if new cables are pulled through them.
C. All pull lines shall be:
   1. Permanently tagged with identification at both ends.
   2. Minimum 1/8" diameter, or larger if so, designated on plans, braided line of polypropylene or Jet-Line #232, or approved equal line of continuous fiber polyolefin. Minimum breaking strength of 1/8 in. line: 200 lbs.

2.04 PRECAST CONCRETE GROUND BOXES/HANDHOLES

A. Ground boxes shall be size as indicated on the drawings. Design loads shall consist of live, dead, impact, hydrostatic and other loads. Live loads shall be for H-20 and/or H-20-S16-44, or as required, per A.A.S.H.O. standard specifications for highway bridges with revisions. Design loads shall be sixteen KIPS. Concrete shall be per ASTM-C-33-64. Lightweight concrete shall conform to ASTM-C-33-64T. Cement shall be Portland Cement meeting ASTM-C-150 Type II standards. Compressive strength shall be minimum 4,000 psi at 28 days.
B. Ground boxes shall be supplied with steel edging in order to make spot welding cover lid to enclosure an option.
C. Ground boxes (48" x 30" or larger): Pre-cast high-density reinforced concrete with end and side knockouts, pulling-in irons. Minimum 4" wall thickness conforming to utility standards with spring assist traffic rated lids. Coordinate size of thin-wall knockouts with manufacturer for conduit entry. Acceptable manufacturers shall be Old Castle, Christy, Jensen or equal.
D. Ground boxes (smaller than 48" X 30"): Pre-cast high-density reinforced concrete with end and side knockouts, and extension as required. Minimum 1-1/2" wall thickness. Acceptable manufacturers shall be Old Castle, Christy, Jensen or equal.
E. Ground Box Covers: Large ground box covers conforming to utility standards with spring assist traffic rated lids shall be spring assisted traffic rated one or multi piece as required, steel checker plate, galvanized with anti-slip surface rated for parkway loading, with hold-down bolts. All boxes shall use H-20 rated traffic covers. No concrete covers shall be allowed.
   1. All Ground Box Covers shall be factory marked “Signal” unless drawings for marking/label indicates otherwise. Covers shall be provided with Penta Head hold down bolts.
F. Utility ground boxes shall be per their requirements. Provide with ground rod as required.
G. All conduits terminating in ground boxes shall be evenly spaced, squarely cut, and bell ends installed.
H. All exterior conduits installed shall be color coded based on project standards. See project details.

I. All new ground boxes shall be located using GPS points (decimal degrees) and documented on the As-Built drawings.

2.05 PENETRATIONS AND SLEEVES

A. All penetrations through fire rated assemblies (walls, ceilings and floors) shall be made with materials and/or sleeves that meet or exceed the fire rating of the assembly.
   1. Approved products: Specified Technologies, Inc. EZ-Path series, sealants, putty and pads.

B. All penetration through non-rated partitions shall be made with conduit sleeves (see Raceway/EMT above) and sealed with draft stop material.

PART 3 EXECUTION

3.01 PATHWAYS AND RACEWAY

A. EMT conduit may be used at following locations:
   1. In dry in-wall spaces.
   2. In partitions other than concrete or solid masonry.

3. In exterior locations, except as noted in 3.01.B.

B. Rigid steel conduit and fittings shall be used for vertical risers and on top of all roofs, overhangs, walkways and canopies.

C. All raceways installed in interior exposed locations shall be surface mounted raceway (Wiremold) by Legrand.

D. Provide flexible connections of short length (4 foot maximum) to equipment subject to vibration or movement and to all motors. Provide a separate bonding conductor in all flexible connections, except as provided for in CEC 250-91 (b) Ex1.

E. Portable buildings shall have weather-proof flex transition from underground to building conduits for both high/low voltage systems.

F. Install exposed conduit run neatly, parallel to or at right angles to structural members. Maintain a minimum of 12 inches of clearance from steam or hot water pipes. All installed unistrut / strut channel supports should allow for future conduit attachments. The width of unistrut / strut channel to match the width of the closest attached junction box. See drawing details for attachment requirements.

G. Supports: Support conduit with two-hole straps or unistrut / strut channel where shown and/or specified. Coordinate supports with architectural details. Secure to wood structure by means of bolts or lag screws, to metal by means of shallow self-tapping screws, to concrete by means of insert or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry or stucco by means of toggle bolts. Straps, expanders and shields shall be steel or malleable iron.

H. Spacing for all EMT and rigid steel conduit supports shall be as follows unless otherwise specified in drawing details:
   1. Surface conduits, roof mounted:
      a. Spacing of supports shall comply with CEC Article 344, Table 344-30(B)(2) and 2022 CBC 1603A.
      b. Construction of roof supports shall comply with roofing manufacturer's requirements.
      c. Roof supports shall be securely fastened to the roof with a gluing system approved by the roof manufacturer.
      d. Route conduits parallel with mechanical piping and along building lines.
      e. Provide ground wire in conduits.
   2. Surface conduit spacing and supports and unless otherwise specified or shown on drawing details:
      a. EMT – Size 3/4” to 1-1/2” – 4’ maximum spacing (3 each supports per 10’ conduit length) and 12” from each end of conduit at coupling, connector or 90-degree bend.
      b. EMT – Size 2” to 4” – 4’ maximum spacing (3 each supports per 10’ conduit length) and 12” from end of conduit at coupling, connector or 90-degree bend.

c. Rigid steel – Size 3/4" to 1" – 4' maximum spacing (3 each supports per 10' conduit length) and 12" from each end of conduit at coupling, connector or 90-degree bend.
d. Rigid steel – Size 1-1/2" to 2" – 10' maximum spacing (1 each supports per 10' conduit length) and 12" from end of conduit at coupling, connector or 90-degree bend.
e. Rigid steel – Size 3" to 6" – 10' maximum spacing (1 each support per 10' conduit length) and 12" from end of conduit at coupling, connector or 90-degree bend.

I. Do not install conduit in the "section" of concrete slabs, except for perpendicular penetrations. Refer to Structural Drawings for specific details.

J. Conduits installed in contact with concrete or earth shall be:
1. Install PVC conduit in a 3" sand or fine earth (passed through 1/8 in. screen) envelope below ground. Provide a minimum of 3" of sand or fine earth at the bottom of the trench before laying conduits.
2. Risers, sweeps, bends greater than 30 degrees, shall be PVC-wrapped, or rigid steel conduit with a minimum inside bend radius as follows unless otherwise specified:

Conduit Size (Inches - Nominal)	Minimum Bending Radius (Times conduit size)
2" and smaller	6" Inch
2" – 4"	24" Inch

3. When installing underground conduits to specified depth, depth shall be taken from the top of the conduit to the finished grade level. Unless otherwise specified, underground conduits shall be installed with top side not less than 24" below finished grade except that utility company primary conduit shall be 30" minimum below finished grade or as required to meet utility company standards. All conduits inside foundation line shall be not less than 2" below sub grade.
4. The minimum size of conduits outside the foundation line shall be 1", 3/4" inside the foundation line.
5. Place two 3" wide fluorescent orange non-biodegradable plastic tapes on both sides of trench at 12" below grade, labeled "CAUTION FIBER OPTIC LINE BURIED BELOW". Tape shall be continuous for full length of trench.
6. Contractor shall install a #10 insulated wire at the same depth as the underground conduits. The #10 insulated wire shall be continuous for full length of trench and terminated on unistrut / strut channel at the riser or grounding strip at ground box.

K. Above ground conduits shall have a minimum inside bend radius as follows unless otherwise specified:

Conduit Size (Inches - Nominal)	Minimum Bending Radius (Times conduit size)
2" and smaller	6" Inch
2" – 4"	24" Inch

L. If conduit is designated for low voltage use, no more than a total of 270 (3 ea. 90-degree bends, max.) degrees of conduit bend radius will be allowed between boxes.

M. All junction boxes shall be connected to conduits using appropriate connecting hardware (i.e. box connectors)

N. The use of conduit body LB, SLB or LBT fittings for information, communication, and technology systems is strictly prohibited.

O. Clean, prepare, and paint all exposed conduit, junction boxes, unistrut, fittings and accessories except rooftop mounted rigid steel conduit to match the surface in which it is installed.

3.02 EXPANSION JOINTS

A. Provide conduit expansion fitting in each conduit run, which is mechanically attached to separate structures to relieve strain caused by shift of one structure in relation to another.

B. Provide conduit expansion fitting in each conduit run wherever it crosses expansion joint in structure to which it is attached.

C. Provide expansion fittings where expansion and contraction are a consideration in long runs of exposed conduits (one inch [1"] or larger conduit in excess of one hundred feet [100']).

3.03 PROOFING

A. Before pulling any conductors into a PVC conduit, the conduit shall be first be proofed by pulling through a mandrel of a diameter ¼ in. smaller than the conduit inside dia., followed by a swab of the same diameter as the conduit inside diameter. Proofing will be done in the presence of Construction Manager for verification.

3.04 SURFACE MOUNTED RACEWAYS

A. Surface mount non-metallic raceways shall be used as required to provide communications cabling services as shown on installation drawings.

B. The Contractor will provide and install all surface mounted non-metallic type raceway and appropriate fittings to provide a safe and complete installation. All installation must meet manufacturers recommended installation procedures.

C. All non-metallic raceway boxes, bases, covers and fittings shall be of the same manufacture.

D. Wire management clips shall be installed in all raceways (vertical and horizontal runs) on maximum of 24” on center spacing. If utilizing existing raceway for new wires, wire management clips shall be installed.

E. The non-metallic raceway components shall meet all of the CEC applicable articles.

F. Multiple channel surface mounted raceways shall be color-coded and marked with a permanent marker on the inside of the channel and across the entire length of the channel blue for data, telephone, and IPTV and red for power. These color-coded channels shall be installed consistently with the same relative position of color on the top and the bottom throughout the site in accordance with CEC Article 352-26.

G. The non-metallic raceway may have a factory-applied adhesive for mounting to the substrate. The contractor shall not use the factory-applied adhesive, instead the Contractor shall fasten raceways every 16" on center to studs wherever possible utilizing appropriate fastening methods by the manufacturer. The contractor shall use pan head type screws, sized in accordance with the manufacturer installation instructions. In addition to the manufactures mounting instructions, mounting hardware and anchor types recommended for any raceway that shall be mounted to the building or structure.
   1. Sheet rock / drywall / wall board: by means of Easy Anchor, toggle bolt, other spread type anchor with load distribution, or approved equal.
   2. Concrete / cinder block / solid masonry: by means of expanding compression type lag, expanding compression type bolt, expanding compression type all tread with nuts, or approved equal.
   3. Tile / Stucco / hollow masonry: by means of toggle bolts or approved equal.
   4. Wood: by means of lags, pan head wood screws, or approved equal.
   5. Metal: by means of a clamp, self-tapping pan head screw, or approved equal.

H. The raceway is to be manufactured of rigid PVC compounds. The cover shall have a matte texture.

I. A full complement of fittings must be available including, but not limited to, extension boxes, 90-degree elbows, tees, inside corners, outside corners, fixture boxes, wire clips, and device boxes. All fittings must match the color of the raceway cover.

J. The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics.

K. At locations where raceway is mounted below 48 inches from the finished floor the contractor shall install a device bracket every 30” on center throughout the entire length of the raceway system. Any unused slots on the device bracket shall have a blank plate installed.

L. Do not use pulling means, including fish tape, cable or rope, which can damage the non-metallic surface raceway.

M. Raceway shall not have covers installed until fastening and cabling is approved by the inspector of record.

3.05 POWER AND COMMUNICATION POLE

A. In areas with system furniture and/or office furniture is set up in open areas, the cables shall be routed through an existing power pole, or a contractor supplied and installed power pole from the ceiling space to the floor.
B. Power pole shall be properly anchored to the ceiling and the floor using the recommended mounting instruction from the manufacture.
C. Contractor may utilize an existing power pole provided fill capacities are not exceeded.
D. Project manager or Owner/Architect/Engineer representative shall determine how system furniture areas will need to be fitted with a power pole device.
E. In the event that a power pole is not in place to serve the specific systems furniture area, the contractor is required to provide and install one.
F. Contractor shall obtain clarification if method of installation is unclear regarding how a power pole will be installed prior to submission of contractor's bid.
G. Where cables pass through a hole in the pole, the contractor shall provide and install a grommet around the hole in the power pole to protect the wire and cable. The grommet will be fitted with either a plastic or rubber shutter device that provides a tight seal around the wire and cable. In addition, the contractor shall provide and install a spiral wrap type plastic device, which shall serve as a protected raceway from the power pole to the system furniture. The contractor shall then route the cables into the systems furniture raceways to the designated point of attachment at each drop location.
H. The contractor will terminate the wire and/or cable on the device outlets, which will be installed in the appropriate manner for the type of furniture being installed.

3.06 FLOOR MONUMENTS

A. Contractor shall provide and install approved floor monuments in those areas that cables are routed below the floor space and or require termination of a drop outlet in an open area that cannot be served either by a fixed wall or power pole.
B. Contractor shall provide all necessary labor and materials to saw cut floor, core holes and patch substrates/surfaces necessary to accommodate the installation of a floor monument.
C. Contractor shall provide and install a floor monument as specified in construction documents.
D. Where cables pass through a hole in the monument, the contractor shall provide and install a grommet around the hole in the power pole to protect the wire and cable. The grommet will be fitted with either a plastic or rubber shutter device that provides a tight seal around the wire and cable. In addition, the contractor shall provide and install a spiral wrap type plastic device, which shall serve as a protected raceway from the monument to the system furniture. The contractor shall then route the cables into the systems furniture raceways to the designated point of attachment at each drop location.
E. The contractor shall then route the cables into the systems furniture raceways and/or office furniture setup in open areas to the designated point of attachment at each drop location. The contractor will then terminate these cables on device outlets which will then be installed in a high-profile box, which will be surface mounted to the underside of the work surface at each location.

3.07 EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

A. Excavating, backfilling and compacting for conduit, underground pull boxes, vaults and other underground electrical and low voltage utilities shall be performed in accordance with Specification Section 31 00 00 (Earthwork) for Utilities and the Geotechnical Engineering Consultant.

3.08 CONDUIT CAPPING

A. Cap conduits during construction with manufactured seals. Swab out conduits before wires are pulled in.
B. Cap all empty conduits below grade and in pull boxes with manufacturer's caps to prevent entrance of debris, attach pull string to cap.

3.09 CONDUIT PENETRATIONS

A. Penetrations through walls, ceilings, or floors.
   1. Wood, stucco, drywall, and hallow masonry
      a. Scanning for structural members and wall studs:
         i. Contractor shall scan the wall for studs and metal using an electronic stud finder to avoid drilling through a structural member.
         ii. If the contractor is unsure of the building's structural supports, the contractor shall notify the inspector of record and/or project manager to confirm the location before drilling.
      b. Drilling
         i. A pilot hole not exceeding 3/8" diameter shall be drilled through the material for each penetration to confirm placement of penetration on both sides of the wall and before using an auger bit or hole saw to finalize penetration size.
         ii. Final penetration sizes shall take into account the size of the conduit to be installed including box connectors if EMT and angular space requirements for fire or draft stopping.
   2. Concrete, brick, and solid masonry
      a. X-ray scanning
         i. Contractor shall perform or hire out to have each location of each wall penetration x-rayed to confirm the locations of rebar and other structural steel supports.
         ii. If the contractor is unsure of the building's structural supports, the contractor shall notify the inspector and/or project manager to confirm the location before drilling.
      b. Core boring/ Drilling
         i. Contractor shall notify the inspector and/or project manager of the time the core boring/drilling will be performed.
         ii. The contractor shall save all removed material from wall for inspection. Contractor shall take precautions to protect site property from water and debris created by core boring.
         iii. Final penetration sizes shall take into account the size of the conduit to be installed including box connectors if EMT and angular space requirements for dry packing.
      c. Filling angular space / dry packing
         i. Contractor shall fill the angular space between the conduit and the wall with structural grout. The grout shall be even and uniform all the way around the conduit with no gaps or voids.

B. Where conduit passes through walls, ceilings, or floors with connection points to junction boxes or raceway mounted to the same wall as the penetration provide rigid steel or IMC conduit treaded on both ends and secured in place with locking rings on both sides. Bend radius requirements shall be maintained where penetrations are made through the back of raceways; junction boxes with adequate depth shall be installed in order to comply with this requirement.

C. Where conduit passes through walls, ceilings, or floors with connection points to junction boxes or raceway not mounted to the same wall as the penetration provide EMT conduit and secured in place with unistrut / strut channel. Box connectors shall always be used to connect EMT to junction boxes and raceways.

D. Where conduit passes through walls, ceilings, or floors with no connection points to junction boxes or raceway provide rigid steel or IMC conduit treaded on both ends and secured in place with locking rings and large reducing washers on both sides.

E. Where conduit passes through finished walls or ceilings, provide steel escutcheon plates, chrome or painted, as directed. Conduit, which penetrate floor slabs, concrete or masonry walls shall be grouted and sealed watertight at penetrations.

F. Fire stopping:

1. Seal all conduit penetrations through fire rated walls and floors fire and smoke tight in conformance with 2022 CBC Sections 714 & 2022 CEC 300-21.

G. Draft stopping:
1. All non-fire rated walls must be draft stopped and sealed. Submit method to be used for approval by inspector and/or project manager. Mineral wool is one product that may be used.

H. Water stopping:
1. All exterior penetrations shall be sealed watertight. The contractor shall use silicon rubber caulk or other approved methods and materials. Submit method and material with inspector and/or project manager.

I. Provide 12" vertical and horizontal clearance for conduit risers through roofs. Coordinate with roof manufacturer to seal roof.

3.10 DEMOLITION

A. Any existing equipment and cable noted to be removed on design plans or abandoned devices and conduit not being reused by this project shall be removed by the Contractor.

B. Removed equipment shall be inventoried and turned over to the Owner/Architect/Engineer or disposed of per the project's instructions.

C. Disturbed surfaces shall be repaired to match original surface condition and prepped for painting.

D. Blank electrical plates colored or painted to match existing surfaces shall be installed over abandoned flush mounted device boxes.

3.11 BOXES

A. Screws shall be used to attach boxes, and must be accurately placed for finish, independently and securely supported by adequate wood backing or by manufactured adjustable channel type heavy-duty box hangers. Boxes with metal box hangers shall be attached to metal studs. Box hangers shall be securely tied or welded (where permitted) to metal studs. Paint weld with rust inhibitor. Boxes installed in masonry tile or concrete block construction shall be secured with auxiliary plates, bars or clips and be grouted in place.

B. Locate outlets at the following heights above floor to the center of the device or handle unless otherwise noted on Drawings, Specifications, 2022 CBC 11B-308 or as required to meet ADA handicap requirements.
   1. Convenience Outlets: 18" AFF (6" above counter or splash not to exceed 40" above finished floor).
   2. Telephone Outlets: 18" AFF (45 in. for wall phone).
   C. Install pull boxes as required in accessible spaces but do not install in finished areas unless approved by the Owner/Architect/Engineer.

D. Outlet boxes on opposite sides of wall requiring protected openings shall be separated by a horizontal distance of twenty-four (24") inches, Title 24 Part 2, 713.3.2 Exception #1.

E. For sound control, separate outlets on opposite sides of walls 16" minimum. Where outlets are less than 16" or in sound rated walls, seal airtight with fire rated sheet putty pads. Fill gap between junction box and wall with acoustical sealant all around perimeter of junction box. Fill conduits larger than 1 1/4" with fire rated putty.

F. Installation of conduit and outlet boxes in fire-resistive walls and partitions shall comply with Title 24, Part 2, Section 713.

G. Installation of conduit and outlet boxes in fire-resistive floors, floor-ceiling or roof-ceiling assemblies shall comply with Title 24, Part 2, Section 713.

3.12 GROUNDING AND BONDING

A. Ground fittings shall be UL approved for each application as installed, installed and connected to system in accordance with 2022 CEC Code requirements.

B. Neutral conductors and non-current carrying parts of equipment at each installation shall be grounded in accordance with applicable code. Ground conductor shall be copper having a current capacity in accordance with CEC Section 250.

C. All equipment cases, motor frames, etc. shall be completely grounded to satisfy requirements of CEC. Install bond wire in flexible conduit. Install copper bond wire, sized in accordance with CEC, in all nonmetallic raceways and bond to all metallic parts using approved fittings.

D. Service ground conductor shall be connected to a "Ufer" encased ground and bonded to the cold-water pipe system.

E. Ground resistance of made electrodes shall not exceed 25 ohms, per CEC Article 250-84. Perform ground resistance test prior to connection.

F. All connections shall be made with solder less connectors or molded fusion-welding process. Solder less connections shall be made to conform to Code requirements or manufacturers requirements if more stringent.

G. Provide ground wire in all rooftop conduits.

3.13 FIELD TESTING

A. General: Perform field test in the presence of the Owner's Representative except as otherwise specified. Provide required labor, materials, equipment and connections to perform tests. Document results and submit them to the Owner's Representative. Repair or replace all defective work.

B. Perform Megger test on all grounding legs:
   1. Notify the Owner/Architect/Engineer when installed cable is ready to be tested.
   2. Apply Megger tests. Supply labor, materials and test equipment required to perform continuity checks and Megger tests. Submit test data for approval.
   3. If any failure is detected, locate failure, determine cause and, as directed by the Owner/Architect/Engineer, replace or repair cable or conductor to satisfaction of the Owner/Architect/Engineer at no increase in Contract Sum.
   4. Subject feeder cables rated 600 volts AC to one (1) minute withstand test, or until stable reading is obtained with 1000-volt Megger. Provide written report of Megger test results. Test report to include all test conditions.
   5. Do not Megger test any cables after connecting test equipment, unless specifically directed to do so by the Owner/Architect/Engineer.

3.14 CLEANING, PATCHING, AND PAINTING

A. Brush and clean work prior to concealing, painting and acceptance. Performed in stages if directed.

B. Clean and repair soiled or damaged painted exposed work and match adjoining work before final acceptance.

C. Remove debris from inside and outside of material, equipment and structures.

D. All conduit, connectors, j-boxes, and accessories shall be painted white with primer.

E. All mud-rings shall be color code painted for inspection.

3.15 CABLING INSTALLATION AND DISTRIBUTION

A. Cable shall be routed in appropriate conduit by system type as outlined in details. Contractor is to contact Owner/Architect/Engineer representative when this requirement can’t be met.

B. Cable shall not be exposed at any point in the cable path. Contractor is to use appropriate pathway for the situation (i.e. above drop ceiling, inside wall, conduit, or non-metallic surface raceway).

C. Cables shall be protected and sleeved with a conduit in locations where cables need to pass through walls, floors, or hard ceilings. Contractor shall install rigid steel or IMC conduit threaded on both ends and secured in place with locking rings and large reducing washers on both sides. Bend radius requirements shall be maintained where penetrations are made through the back of raceways; junction boxes with adequate depth shall be installed in order to comply with this requirement. The fire rating of the wall must be maintained during and after installation.

D. At solid wall locations such as plaster, brick, concrete, cinder block, tile, reinforced concrete, Contractor will provide and install surface mounted non-metallic raceways or equivalent. The use of different series raceways is required at locations where cable fill capacities are exceeded.

E. Cables will be run vertically inside the wall and into the ceiling space. Terminations on stud walls will be accomplished with cut-in type electrical boxes with a 1” conduit (flex or EMT) extended from the box within the wall to ceiling access space.

F. Cables routed above drop ceilings shall be run in corridors wherever possible in order to avoid furniture and work areas so that access to the cables is unencumbered.

G. The cables are to be as accessible as possible, placed above all other items in the ceiling, including ducts and supports.

H. Service loops:
   1. Service loops in Ground boxes and J-boxes shall not be installed unless with prior written approval or to allow for the minimum bend radius specified by the manufacturer:

2. Cables routed above drop ceilings shall be run in corridors wherever possible in order to avoid furniture and work areas so that access to the cables is unencumbered.
3. Fiber feeder cable:
   a. Shall be a minimum of 10’ at all MDF and IDF locations.
   b. Shall be routed around the perimeter of the ground box as cable exits and enters each side of the ground box. No visible service loop required. Cable shall be secured to the side of the ground box and not rest on the bottom of the box.
4. Intercommunications feeder cables:
   a. Shall be routed around the perimeter of the backboard in which it is terminated on.
   b. Shall be routed around the perimeter of the ground box as cable exits and enters each side of the ground box. No visible service loop required. Cable shall be secured to the side of the ground box and not rest on the bottom of the box.
5. Twisted Pair Category 6/6A cable:
   a. Shall be a minimum of 6’ at all MDF and IDF locations.
   b. Shall be routed around the perimeter of the ground box as cable exits and enters each side of the ground box. No visible service loop required. Cable shall be secured to the side of the ground box and not rest on the bottom of the box.
   c. Shall be a minimum of 9” behind each station location.
6. Service loops, Intercommunications:
   a. Horizontal cables:
      i. Shall be a minimum of 3’ at all head end termination locations.
      ii. Shall be a minimum of 12” behind each speaker.
      iii. Feeder/Backbone cables shall be routed around the perimeter of the backboard in which it is terminated on.

A. The cables are to be as accessible as possible, placed above all other items in the ceiling, including ducts and supports.
B. Do not use pulling means, including fish tape, cable or rope, which can damage the non-metallic surface raceway.
C. Use pulling compound or lubricant, with prior Owner/Architect/Engineer approval, only when necessary.
D. Pulling compound shall be a water base pulling lubricant that will not deteriorate cable or conduit.
E. Cables shall not be pulled across sharp edges. If sharp edges are present a small sleeve, insulating insert, or grommet shall be installed to protect the cable.
F. Cables shall be pulled free of sharp bends or kinks.
G. Cables shall not be forced or jammed between metal parts, assemblies, etc.
H. Cables shall not be pulled across access doors and pull box covers. Access to all equipment and systems shall be maintained.
I. Manufacturer's specifications for pulling stress and minimum bend radius shall not be exceeded on any cable.
J. Install or replace pull-string after installing cable in any EMT, IMC, Rigid, or PVC conduits.
K. A maximum fill capacity of 40% will be deemed acceptable for conduits and 75% of raceway and surface pathway. Contractor shall inform Owner/Architect/Engineer / Owner/Architect/Engineer representative in writing if this requirement cannot be met. If the Contractor fails to inform the Owner/Architect/Engineer or its representative, any labor involve in rerouting cables in such conduit or raceways shall be the sole responsibility of the Contractor
L. Cable shall be identified with a machine-printed tag identifying the system type, source or head end location, and destination location in all access points (i.e. junction boxes, ground boxes, MDF, IDFs, etc.) and as they enter or exit the conduit pathway.

M. Contractor will assess whether or not the ceiling space is a plenum air return, which shall dictate the use of the listed plenum type or PVC type cable required in the materials specification section. Any cable installations that shall be pulled through underground conduit will require Outside Plant (OSP) cable. OSP cable are limited to a length of 50' inside a building.
N. Power feeds of greater than 220 volts shall not be run parallel to UTP, Speaker or other system cables. Parallel runs of greater than 20 feet require a minimum separation distance of 3 feet, or 18 inches if cables are contained in a metallic conduit, which is grounded.
O. All power feeds crossing the path of UTP, Speaker or other system cables at right angles shall be a minimum of 6 inches in distance from the UTP cables.
P. There shall be a 6-inch separation between the cables and the light fixtures and motors. Contractor will notify the Owner/Architect/Engineer or it's representative in the event this requirement cannot be met.
Q. All cable/cabling shall be kept 6 inches away from any heat source, i.e., HVAC ducting, steam valves, etc.
R. Fiber Optic cable/cables shall be identified with a tag identifying cable type, destination and origin, and date installed, every 30 feet when installed in open trays or suspension systems in ceilings.
S. Station Cable (UTP) or (STP) runs are not to exceed 290 feet.
T. Cable splicing at any point of any cable installed by the contractor is unacceptable without specific Owner/Architect/Engineer and designer approval.
U. No cabling is allowed to rest on any ceiling tile or suspension system unless specifically authorized by the Owner/Architect/Engineer. Strapping or mounting to any existing wires (e.g., lighting, ceiling grid, conduits, etc.) is not permitted.
V. Cables, regardless of classification, shall not be bundled in larger quantities than 24.
W. Cables bundled in quantities of 24 or larger shall be securely mounted to building structure (i.e. stud, beam, or other framing member.) with Contractor supplied cable tray unless otherwise specified on design drawings and details.
X. Cables bundled in quantities less than 24 shall be securely mounted to building structure (i.e. stud, beam, or other framing member.) with Contractor supplied J-hooks every 4 feet unless otherwise specified on design drawings and details.
Y. Cables bundled in junction boxes shall be neatly routed and secured to box with Contractor supplied Velcro straps typically 4 per box.
Z. Cables shall be securely supported to building structure (i.e. stud, beam, or other framing member.) within 12 inches of any conduit or raceway entrance or exit. Cable tray may be required if not noted on plans.
AA. Contractor will place all UTP, Speaker and other system cables in the ceiling area on Contractor supplied and installed wire hangers or in floor spaces and raceways. Cable tray may be required if noted on plans.
BB. Insulation shall be removed to expose shielding and conductors/fibers to the exact length required by manufacturer for proper termination of plugs, pins and fiber terminations.
    1. Wires and shielding shall not be nicked or damaged in any way upon termination of pins and closure of plug assembly.
    2. Pins and plugs, upon termination, shall not be damaged in any way.

END OF 27 05 00

SECTION 27 13 00 - COMMUNICATION BACKBONE CABLING

PART 1 – GENERAL

1.01 SUMMARY

A. This section specifies equipment, accessories, materials, installation, configuration and testing requirements for a complete and operable Communications Backbone Cabling system. The system shall provide highly reliable and high-performance data communication from main distribution frame (MDF) to each intermediate distribution frame (IDF) or end points requiring fiber optic cabling.

1.02 SCOPE

A. The work will include but not be limited to the following objectives:
1. For new construction – provide, coordinate, and install all required components and accessories as outlined in the design documents for a complete and operable system.
2. For existing construction – provide, coordinate, and install all components and accessories as outlined in the design documents to modify the existing system while maintaining compliance and to seamlessly integrate the new components into the existing campus' system.
3. Labor and Materials: The Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation and completion of the Work.
4. The Contractor shall furnish and install all new conduit/raceway and wire as indicated on the project drawings and/or as required to provide a turn-key system to the District.
5. The Contractor shall terminate all strands of fiber at each fiber enclosure. All cables shall be installed with a minimum 10' service loops at MDF/IDF locations. Fiber will be terminated using LC type connectors.
6. Service loops shall be secured to backboard or rear of cabinet using a pre-manufactured fiber optic wheel with Velcro straps. If installed at rear of cabinet, the wheel shall be placed at a height that will not interfere with equipment to be installed in the cabinet.
7. If applicable, existing systems shall remain operable until new systems are accepted and approved by the District or its representative.
8. The contractor shall complete all required project closeout documentation in a timely fashion.
9. Testing of fiber and connections to insure a complete and operable end-to-end data connection using ANSI/TIA 568-C and ANSI/TIA/526-7 testing guidelines for multi-mode fiber.
10. Fiber installs to carry Leviton Limited Lifetime warranty (see Division 27 05 00 for requirements)

B. VOICE COPPER BACKBONE- This work relates only to sites where the District has not activated a Voice over IP platform or if special circumstances requires an analog copper connection such as a fax machine, intercom connection tie-in, HVAC controller, etc. The work will include but not be limited to the following objectives:
1. MPOE
    a. Backbone feeder cables shall be at a minimum Category 5, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 8 pairs.
    b. All pairs are to be terminated as follows:
        i. At the MPOE end, on 66-blocks.
        ii. At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

2. Buildings requiring an analog fax connection
   a. backbone feeder cables shall be at a minimum Category 5, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 4 pairs.
   b. All pairs are to be terminated as follows:
      i. At the IDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.
      ii. At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

3. Buildings requiring an analog tie-in to the intercommunications head end unit.
   a. backbone feeder cables shall be at a minimum Category 5 SHIELDED cable, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 4 pairs.
   b. All pairs are to be terminated as follows:
      i. At the IDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.
      ii. At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

1.02 RELATED REQ UIREMENTS

A. Division 01 00 00 – General Requirements
B. Division 27 00 00 - Communication
C. Division 27 05 00 – Common Work Results for Communication Systems
D. Division 27 11 00 – Equipment Rooms and Enclosures
E. Division 27 15 00 – Communication Horizontal Cabling

1.03 INDUSTRY GUIDELINES AND STANDARDS

A. ANSI/TIA-568-1.D: Commercial Building Telecommunications Cabling Standard.
B. ANSI/TIA -568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
C. ANSI/TIA -568-3.D: Optical Fiber Cabling Components Standard.
D. ANSI/TIA/EIA-569-D: Telecommunications Pathways and Spaces.
E. ANSI/TIA -568-0.D: Measurement of Optical Power Loss of Installed Fiber Optic Cable Plant
F. ANSI/TIA -598-D: Optical Fiber Cable Color Coding.
G. ANSI/TIA -606-C: Administration Standard for Telecommunications Infrastructure.
H. ANSI/TIA -607-C: Generic Telecommunications Bonding and Grounding (Earthing) Requirements for Customer Premises.
I. ANSI/TIA -758-B: Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
J. Fiber optic cable, wire and connectors shall be installed as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended functions. As such, all of the following: National Fire Code (NFPA), National Electrical Code (NEC), California Electrical Code (CEC), California Building Code (CBC) & Local Codes shall be followed.

1.05 QUALIFICATIONS

A. The contractor shall possess a California C7 or C10 license.
B. The Contractor or Subcontractor shall be Leviton certified to provide and install cable plant with 5 years documented experience.
C. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.

1.06 REFERENCES
A. See Division 27 00 00.
1.07 SYSTEM REQUIREMENTS
A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing data cable plan system.
1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS
A. See section 27 00 00 for requirements.
1.09 SUBMITTALS
A. See section 27 00 00 for requirements.

PART 2 – PRODUCTS

2.01 DATA FIBER BACKBONE

A. See Appendix at the end of this document for pre-approved materials.

B. All products shall be new and unused and shall be of manufacturer's current and standard production.

C. Contractor shall confirm all equipment part numbers with the District prior to ordering equipment and updating submittals as required.

D. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.

E. Product Availability

1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

2.02 CONDUIT AND RACEWAY

A. See division 27 05 00 for conduit and raceway requirements.

2.03 WIRE AND CABLE

A. Refer to Appendix A for Pre-approved manufacturers and part numbers.

B. Provide all new wire and cable required to install systems as indicated on design documents.

C. Fiber optic cables shall be tight buffered laser optimized, 6 strands for Elementary Schools and 12 strands for Middle and High school. Any cable shall not exceed a .30” diameter.

1. Fiber optic cable shall have a minimum effective modal bandwidth of 3500 MHz/Km. See Appendix at the end of this document for approved material.

D. Fiber Optic connectors for multi-mode shall be industry standard LC type connectors. See Appendix at the end of this document for approved material.

E. MDF rack mount fiber optic enclosures (LIU) shall be as outlined in Appendix at the end of this document and completely loaded with Ceramic ferrule Duplex LC Packs unless listed otherwise in drawings and details or approved equal.

F. Furnish one (1)-meter LC to LC duplex cross over fiber patch cord for every two terminations at IDF locations and one (2) meter LC to LC duplex cross over fiber patch cord for every two terminations at MDF location. The patch cords shall have connectors with ceramic ferrules. All patch cords shall be packaged with a factory performance certification report. Verify all lengths before ordering.

2.04 FIBER OPTIC CABLE MANAGEMENT RING

A. Re-closable ring cable management device. Ring should be 24 inches in diameter for Copper Multipair, OSP, or Armored cable, and 12” diameter for Indoor fiber cable.

B. Ring to be mounted on the backboard at the OSP fiber entrance as indicated. Six hook and loop style loops attached.

C. Approved Products

1. Leviton 24” Velcro fiber spool, 48900-OFR
2. Leviton 12” Velcro fiber spool, 48900-IFR

2.05 PATCH CORDS

A. See section 27 16 00 for requirements

2.06 LOW VOLTAGE ENCLOSURES AND PATHWAYS

A. See section 27 05 00 for additional requirements.

PART 3 – EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. The cable plant system shall only be installed by Contractors who are qualified to install, service and maintain the cable plant system.
B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience before the Bid Opening Date.

3.02 EXAMINATION

A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to the District.
B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

3.03 PREPARATION

A. The Contractor shall order all required parts and equipment upon receipt of approved product submittals.
B. The Contractor shall verify the availability of power where required.

3.04 SHOP DRAWINGS

A. See section 27 00 00 for requirements
B. Submit drawings for review and approval by Project Manager.

3.05 INSTALLATION

A. See 27 05 00 for additional routing requirements
B. The cables will be routed to their respective Main Distribution Frame (MDF) or Intermediate Distribution Frame (IDF) utilizing the shortest path possible while maintaining right angles to the building structure.
C. Contractor is required to adhere to the parameters in this section whether or not existing equipment has been placed by Contractor and/or others.
D. Contractor will notify the District if any of the requirements cannot be met prior to bid.
E. Voice copper backbone
    1. Terminations shall be T568B configuration unless otherwise specified.
    2. Labeling
        a. Wiring termination locations shall be labeled to corresponding pairs at the MDF and IDF.
        b. Cables shall be labeled no more than 3" back from each end of the termination point with a cable label that matches the patch panel labeling.
        c. Contractor will provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.
        d. Handwritten labels are not acceptable.
        e. Each pair shall have a unique label throughout the site. This would allow a cable management system to track each cable pair.
        f. Labeling Scheme
            1) Closet labeling: 66-block or surface-mount quickport box shall be labeled with the destination MDF or IDF #, sequential feeder pair number only. The labeling itself shall be in a white background with black lettering.
F. Data Fiber Backbone
    1. The District has standardized on materials that provide component quality and maintainability. Refer to the Appendix A at the end of this specification for pre-approved material.

2. Fiber Optics Cable Installation and Testing.
   a. Service loops shall be secured to backboard or rear of cabinet using a pre-manufactured fiber optic wheel with Velcro straps. If installed at rear of cabinet, the wheel shall be placed at a height that will not interfere with equipment to be installed in the cabinet.
   b. Fiber cables shall be securely mounted to the fiber enclosure using zip ties in at least two locations around the jacket to prevent cable twisting and movement. In addition, the Kevlar or strength member shall be bolted, tied, or securely fastened to the enclosure.
   c. Fibers strands shall be neatly organized in the enclosure with individual bundled paths from each cable to the bulkheads in which they are mounted.
   d. Fiber strands shall be made to rest in their final position without tension or stress of any kind.
   e. All spare optical ports and connectors shall have a dust cap in place to protect from the environment.
   f. Contractor shall provide and install blanks in unused spaces of the fiber enclosure.
   g. All unused optical ports on the LIU shall have protective covers that prevents dust and particles to enter the port.

3. Fiber Optics Labeling
   a. Fiber termination locations shall be labeled to corresponding fiber strands pairs at the MDF and IDF.
   b. The labeling scheme shall be submitted by the contractor for District / District representative approval prior to installation.
   c. Contractor is expected to provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.
   d. Handwritten labels are not acceptable.
   e. Labeling requirements
      1) Cables shall be labeled approximately 12 inches back from the point where the cable enters the fiber enclosure with a cable label that identifies the origin and destination of the cable.
      2) Closet labeling; each connection shall be labeled denoting each strands number, origin and destination.
      3) The type (single-mode or multi-mode) of fiber optic cable used shall be clearly labeled on the fiber patch panel per drawn details.
      4) Color-coding shall conform to ANSI/TIA specifications.
   4. Fiber Optics Testing
   a. All optical test equipment shall have current, traceable calibration certification.
   b. If fiber is supplied to Contractor by the district shall be tested before installation, while still on the shipping reel, using an optical time domain reflectometer (OTDR). The test results shall be compared to the manufacturers test results. A discrepancy of more than 1 dB on any fiber in either window indicates possible shipping damage and the fiber shall be returned to the supplier. The test results shall be maintained in a file for future reference.
   c. All fiber shall be tested after installation according to the Method A procedures described in ANST/TIA-568-C.
   d. Power meter test equipment shall produce a machine generated test report

containing the minimum of the following test information:

1) Contractor's Name
2) Operator's Name
3) Customer's location
4) Closet Location
5) Cable ID
6) Test Summary – i.e. Pass/Fail
7) Date and Time of test
8) Test Standard
9) Equipment serial numbers
10) Length in Feet
11) Test direction – i.e. MDF to IDF=A-B / IDF to MDF=B-A
12) Wavelength
13) Optical loss in dB
14) Optical loss limit
15) Reference setting
16) Reference setting date and time

(Most bi-directional test sets will meet these criteria providing the operator enters the proper information. Contractor shall notify the project manager before testing if there is any question regarding this requirement)

e. In addition to power meter testing, OTDR testing is to be performed in any location where the fiber is not continuous, i.e. coupled LC connectors (soft splice), fusion splice, and mechanical splice. When testing with an OTDR the contractor shall utilize a test lead or launch cable a minimum of 100 meters in length and a trail test cable a minimum of 100 meters in length. The contractor shall set a marker at the start and end of the tested cable on each test result and the difference in loss between the two markers shall be noted on the test report. The results of these tests (printed OTDR result power meter attenuation results) shall be provided by the installer as documentation of the quality of installation and as a baseline for future troubleshooting. The results shall be compared to the pre-installation test results for significant changes.

f. The multi-mode cable shall comply with maximum individual fiber loss limits in accordance with ANSI/TIA-568-C Multimode, OM4.

g. Aerial fiber cable mounting hardware shall be matched to the all dielectric self-supporting (ADSS) fiber cable exactly and be installed in accordance with mounting hardware and cabling manufacturers specifications.

3.06 WORKMANSHIP

A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship. Contractors unfamiliar with the District's standards shall familiarize themselves with the District's standards and requirements prior to beginning work.

B. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.

C. Perform Work with persons experienced and qualified to produce workmanship specified.

D. Maintain quality control over suppliers and Subcontractors.

E. Quality of workmanship is considered important. The District's Project Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

3.07 CABLE

A. Design, layout, size, and plan new cable runs as required.
B. All wire and cable passing thru metalwork shall be sleeved by an approved grommet or bushing.
C. Conduit/raceway fill shall not exceed 40 percent of interior cross-sectional area.
D. Identify all cables at terminations. Identification shall be made with an approved permanent label, machine generated 1/4" black letters on white tape (Brady or equal.)
E. Underground cable shall be rated for use.
F. Neatly dress and tie all cabling.

3.08 CONDUIT AND RACEWAY INSTALLATION

A. Design, lay-out, size and plan new conduit and raceway systems as required.
B. Install conduit and raceway in accordance with Division 27 05 00 requirements.

3.09 PENETRATIONS, CUTTING AND PATCHING, DEMOLITION, PAINTING

A. See section 27 05 00 for requirements

3.10 FIELD QUALITY CONTROL AND TESTING

A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to inspect wiring, devices and system operation.
D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
E. Notify District when ready to perform a re-inspection of the installation.

3.11 EQUIPMENT INSTALLATION CONFIGURATION AND TESTING

A. See section 27 21 00 for requirements

3.12 AS-BUILT DRAWINGS AND TEST RESULTS

A. See section 27 00 00 for requirements.

APPENDIX-A
(Unless Otherwise Specified on Construction Document Plan Sheets)

PATCH PANEL AND WIRE MANAGEMENT

DESCRIPTION	MANUFACTURER	PART NUMBER
48-Port Snap-in Patch Panel, 2U Wire management bar included	Leviton	49255-D48
Horizontal Cable Management	Leviton	49253-LPM

FIBER / COPPER MATERIAL

DESCRIPTION	MANUFACTURER	PART NUMBER
Leviton 2000i SDX Series fiber housing a) 19" rack mounted units completely loaded with Zirconia Ceramic LC fiber adapter plates	Leviton	1U = 5R1UH-S03 2U = 5R2UH-S06 4U = 5R4UH-S12
Fiber Wall Mount Enclosure	Leviton	5WMNT-01C
Leviton SDF fiber adapter plate	Leviton	5F100-2QL
12-strand OM4 LOMM 50um tight buffered plenum indoor/outdoor rated fiber (no loose tube)	Berk-Tek	PDP012FB3010/F5-I/O-C4(AQU)
4-pair or larger copper feeders		See division 27 15 00

END OF APPENDIX A

END OF 27 13 00

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.01 SUMMARY

A. This section defines equipment, materials, accessories, installation, configuration and testing requirements for a complete and operational Communications Horizontal Cabling system. The system shall provide reliable high-performance data communication from the Main Distribution Frame (MDF) / Equipment Room (ER), Intermediate Distribution Frame (IDF) / Telecommunication Room (TR) or equipment control points to area workstations and communications device locations.

1.02 SCOPE

B. The work will include but not be limited to the following objectives:

1. For new construction – provide, coordinate, and install all required components and accessories as outlined in the design documents for a complete and operable system.
2. For existing construction – provide, coordinate, and install all components and accessories as outlined in the design documents to modify the existing system while maintaining compliance and to seamlessly integrate the new components into the existing system.
3. Labor and Materials: The Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation and completion of the scope of work.
4. The Contractor shall furnish and install all new conduit/raceway and wire as indicated on the project drawings and/or as required to provide a fully functional system to the Owner/Architect/Engineer.
5. The Contractor shall install new Category 6A (Cat 6A) data cabling, station outlets at locations as indicated on drawings. Terminations will be ANSI/TIA standard T568B wiring configuration into RJ45 workstation data jacks.
6. The Contractor shall set up a complete wire management system at each MDF / ER, IDF / TR, this includes wire management organizer(s). Contractor shall provide the following:
    a. One (1) vertical wire manager for each equipment rack to be installed (height to match equipment rack overall units)
    b. One (1) 1RU horizontal wire manager for each new Cat 6A patch panel
    c. One (1) 1RU horizontal wire manager for each switch to be installed
7. The Contractor is required to adhere to current industry standards when distributing and terminating cables:
    a. All Cat 6A cables shall be secured to the rear cable management bar that is included with each of the patch panels.
    b. At the rear of the patch panel, 50% of the cables shall enter the patch panel area from the right side and 50% of the cables enter from the left side. Cables shall be bundled in groups no larger than 25 cables. All bundled cabling shall be similar type per cable separation guidelines.
8. Prior to installation, If the length of the cable run appears to be exceeding 275’ from station outlet to patch panel, the Contractor shall review requirement with Engineer.
9. If applicable, existing systems shall remain operable until new systems are accepted and approved by the Owner/Architect/Engineer or its representative.
10. All Category 6A (Cat 6A) installations shall carry Limited Lifetime warranty (see Division 27 00 00 for requirements).

1.03 RELATED REQUIREMENTS
A. Division 01 00 00 specifications, General Requirements
B. Division 26 specification sections, as applicable
C. Division 27 specification sections, as applicable
D. Division 28 specification sections, as applicable
1.04 CODES AND STANDARDS
A. See specification section 27 00 00 for requirements
1.04 CONTRACTOR QUALIFICATIONS
A. See specification section 27 00 00 for requirements

PART 2 PRODUCTS
2.01 GENERAL
A. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
B. Contractor shall confirm all equipment part numbers with the Owner/Architect/Engineer prior to ordering equipment and updating submittals as required.
C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory installation and operation.
D. Product Availability
    1. Prior to submitting a project bid, the contractor shall determine product availability, delivery time, and shall include such considerations into the base bid for the communications systems scope of work as defined in the construction documents.
2.02 CONDUIT AND RACEWAY
A. See specification section 27 05 00 for additional information and requirements
2.02 WIRE AND CABLE
A. Provide all new wire and cable required to install systems as indicated on construction documents.
B. Category 6A cable shall meet or exceed IEEE 802.3 for Gigabit Ethernet.
C. Category 6A underground cable shall be rated for the application intended.
D. Cable management system shall be installed to provide a complete management system.
2.02 PATCH CORDS
A. See specification section 27 16 00 for additional information and requirements
2.03 LOW VOLTAGE ENCLOSURES AND PATHWAYS
A. See specification section 27 05 00 for additional information and requirements

PART 3 EXECUTION
3.01 INSTALLATION
A. The cables will be routed to their respective Main Distribution Frame (MDF) or Intermediate Distribution Frame (IDF), to Node Termination Point (NTP) utilizing the shortest path possible while maintaining right angles to the building structure.
B. Data UTP:
    1. Data terminations shall be T568B configuration.
    2. Patch panels shall be installed in accordance with manufacturer’s installation guidelines.
    3. Labeling
        a. Handwritten labels are not acceptable.
        b. Cables shall be labeled no more than 4” inches back from each end of the termination

point with a cable label that matches the station outlet labeling.
c. Wiring termination locations shall be labeled to corresponding pairs at the MDF / ER, IDF / TR, and at each station outlet end.
d. Contractor will provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.

4. Labeling Scheme
   a. Workstation labeling:
      i. The faceplate or surface block shall be labeled with the MDF / ER, or IDF / TR number (#), sequential station outlet number for the MDF / ER, or IDF / TR (ex. 1.1-09).
      ii. The labeling itself shall be in a white background with black lettering.
   b. MDF / IDF labeling:
      i. Patch panel shall be labeled with the sequential station outlet number to match station outlet labeling.
      ii. The labeling itself shall be in a black background with white lettering.
   c. Data UTP Testing
      i. All data UTP cable shall be tested after installation according to the procedures and acceptability criteria described in ANSI/TIA Standards for Category 6 or Category 6A cable and connecting hardware. Test at level IIIe compliance or higher.
      ii. Data UTP cable shall meet or exceed requirements for 10Gbps for Cat6A.
      iii. Test results will be submitted per Section 27 00 00.

C. Manufacturer's specification for pulling stress and minimum bend radius shall not be exceeded on any Category cable.

D. Station Cable (UTP) or (STP) runs shall not exceed 295’ feet (90 meters) on the permanent link.

3.02 CABLE

A. Design, layout, size, and plan new cable runs as required.
B. All wire and cable passing thru metalwork shall be sleeved by an approved grommet or bushing.
C. Conduit/raceway fill shall not exceed 40 percent of interior cross-sectional area.
D. Identify all cables at terminations. Identification shall be made with an approved permanent label, machine generated 1/4” black letters on white tape (Brady or equal.)
E. Underground cable shall be rated for use.
F. Neatly dress and secure / strap all cabling.

3.03 WARRANTY, TESTING, AND COMMISSIONING

A. Refer to Division 27 00 00 for requirements.

3.04 CONTRACTOR CLOSEOUT DOCUMENTS AND TEST RESULTS

A. Refer to Division 27 00 00 for requirements.

END OF 27 15 00

SECTION 28 46 00 - FIRE DETECTIONS AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Circuits from protected premises to supervising station, including conduit.

D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

E. Maintenance of fire alarm system under contract for specified warranty period.

F. The fire alarm system shall consist of all necessary hardware equipment and software programming to perform the following functions:
   1. Fire alarm detection operations
   2. Control and monitoring of elevators, smoke control equipment and other equipment as indicated in the drawings and specifications.

G. Thoroughly inspect the existing system and site conditions before bid. Advise the District's Representative of all conditions requiring immediate attention or might cause difficulties that are not addressed, or inferred to, in the contract drawings and specifications prior to new construction and the commencement of the guarantee period.

H. Review the Drawings and Specifications for work and material provided by others that will affect work specified under this Section. Carefully coordinate with other trades, equipment suppliers, contractors, etc. as required to provide a high-quality reliable installation with a minimum of construction delays. All work required to be re-accomplished due to lack of coordination shall be done at the Contractor's expense.

1.01 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage Power Circuits; 1991 (R1995).

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 72 - National Fire Alarm and Signaling Code; 2016.

E. California Building Code (CBC), California Electrical Code (CEC).

1.02 AMERICANS WITH DISABILITIES ACT (ADA)

A. All visual Notification appliances and manual pull stations shall comply with the requirements of the Americans with Disabilities Act or 2019 CBC, whichever is more stringent.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Proposal Documents: Submit the following with cost/time proposal:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
   3. Certification by Contractor that the system design will comply with Contract Documents.
   4. Proposed maintenance contract.

C. Drawings must be prepared using AutoCAD Release 2017.
   1. ARUSD will provide floor plan drawings for Contractor's use; verify all dimensions on ARUSD-provided drawings.

D. Evidence of designer qualifications.

E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
   11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.

12. Certification by Contractor that the system design complies with Contract Documents.
13. Do not show existing components to be removed.

F. Evidence of installer qualifications.

G. Evidence of instructor qualifications; training lesson plan outline.

H. Evidence of maintenance contractor qualifications, if different from installer.

I. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.

J. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Complete set of specified design documents, as approved by authority having jurisdiction.
   2. Additional printed set of project record documents and closeout documents bound or filed in same manuals.
   3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
   4. List of recommended spare parts, tools, and instruments for testing.
   5. Replacement parts list with current prices, and source of supply.
   6. Detailed troubleshooting guide and large-scale input/output matrix.
   7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to ARUSD.
   8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering contracts for remodeling.

K. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
   2. "As installed" wiring and schematic diagrams, with final terminal identifications.
   3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

L. Closeout Documents:
   1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
   2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
   3. Certificate of Occupancy.
   4. Maintenance contract.

5. Report on training results.

M. Maintenance Materials, Tools, and Software: Furnish the following for ARUSD's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
   3. In addition to the items in quantities indicated in PART 2, furnish the following:
      a. All tools, software, and documentation necessary to modify the fire alarm system using ARUSD's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
      b. One copy, on CD-ROM, of all software not resident in read-only-memory.

1.04 QUALITY ASSURANCE

A. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to ARUSD upon completion.

B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, , or installer

C. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
   3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
   4. Contract maintenance office located within 100 miles of project site.
   5. Certified in California as fire alarm installer.

D. Maintenance Contractor Qualifications: Same entity as installer.

E. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

F. WARRANTY
   1. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   2. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

3. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 **MANUFACTURERS (MATCH CAMPUS EXISTING SYSTEM)**

A. Fire Alarm Control Units - Basis of Design: Gamewell FCI.

B. Existing Gamewell FCI fire alarm control panel shall accommodate the new NODE panel. This integration shall result in a fully functional and integrated network as described in the plans and specifications.

C. Fire Alarm Control Units and Accessories:
   1. Provide control units made by the same manufacturer.

D. Initiating Devices and Notification Appliances:
   1. Same manufacturer as control units.

E. Substitutions: See Section 01 60 00 - Product Requirements.
   1. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Existing automatic fire detection and alarm system:
   1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
   2. Protected Premises: Entire building shown on drawings.
   3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards.
      ` `b. The requirements of the State Fire Marshal.
      c. The requirements of the local authority having jurisdiction.
      d. Applicable local codes.
      e. Contract Documents (drawings and specifications).
      f. California Building Code (CBC).
      g. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
   4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
   5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
   6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
   7. Program notification zones as directed by ARUSD.

8. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.
9. Fire Command Center: Location indicated on drawings.
10. Fire Alarm Control Unit: Existing, located at fire command center.
11. Combined Systems: Do not combine fire alarm system with other non-fire systems.

B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
2. Remote Supervising Station: UL-listed central station under contract to facility.
3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.

C. Circuits:
1. Initiating Device Circuits (IDC): Class B, Style 4.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 4.
3. Notification Appliance Circuits (NAC): Class B,

D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.

B. Clearly label components that are "Not in Service."

C. Remove unused existing components and materials from site and dispose of properly.

2.04 COMPONENTS

A. General:
1. Provide flush mounted units were installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit: As specified for Basis of Design above, or equivalent

B. Initiating Devices:
   1. Addressable Manual Pull Stations: Gamewell FCI -
   2. Smoke Detectors: Gamewell FCI - ASD-PL3.
   3. Heat Detectors: Gamewell FCI – ATD-L3.
      a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
         1) Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

C. Notification Appliances:
   1. Weatherproof Speaker: System Sensor SPRK.
   2. Strobes: System Sensor SRL / SCRL
   3. Strobes/Speaker: System Sensor SPSRL / SPSCRL
   4. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

D. FPE10 remote Power Supply with 2-8AH batteries.

E. The Power panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B Style Y rated at 2 amps each

F. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.

G. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

H. Emergency Power Supply:
   1. General: Components include battery, charger, and an automatic transfer switch.
   2. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 5 minutes.

I. Accessories: The contractor shall furnish the necessary accessories

J. Circuit Conductors: Copper; provide 200 feet extra; color code and label.

K. Locks and Keys: Deliver keys to ARUSD.
   1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type

R. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of ARUSD prior to mounting; mount in location acceptable to ARUSD.
   4. Provide extra copy with operation and maintenance data submittal.

S. Storage Cabinet for Spare Parts and Tools: Steel with baked enamel finish, size appropriate to quantity of parts and tools.
   1. Padlock eye and hasp for lock furnished by ARUSD.
   2. Locate as directed by ARUSD.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, CEC 2019, and the contract documents.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
   1. Factory trained and certified personnel.
   2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
   3. Personnel licensed or certified by state or local authority.

C. Conceal all wiring, conduit, boxes, and supports where installed in finished areas

D. Install all wiring in conduit, 3/4" minimum. No exception.

E. Existing Fire Alarm Equipment shall be maintained, and new control equipment and devices shall be 100% compatible with the existing system.

F. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

G. Install instruction cards and labels.

3.02 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose

3.03 INSPECTION AND TESTING FOR COMPLETION

A. Notify ARUSD 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work adjust for proper operation, and retest until entire system complies with Contract Documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. ARUSD will provide attendant operator personnel during diagnostic period; schedule training to allow ARUSD personnel to perform normal duties.
   4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.04 ARUSD PERSONNEL INSTRUCTION

A. Provide the following instruction to designated ARUSD personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: ARUSD furnished classroom, on-site or at other local facility.
   3. Factory Instruction: At control unit manufacturer's training facility.

B. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

C. Detailed Operation: Two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

D. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
   1. Initial Training: One 3-day session, pre-closeout.

E. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

F. Provide means of evaluation of trainees suitable to type of training given; report results to ARUSD.

3.05 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to ARUSD.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

3.06 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to ARUSD, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

D. Provide trouble call-back service upon notification by ARUSD:
   1. Provide on-site response within 24 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to ARUSD.
   3. ARUSD will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble,

correction performed, and parts replaced. Submit duplicate of each log entry to ARUSD's representative upon completion of site visit.

G. Comply with ARUSD's requirements for access to facility and security.

END OF SECTION

SECTION 321313 – CONCRETE PAVING, TRUNCATED DOMES

PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of portland cement concrete paving is shown on drawings, including curbs, gutters, walkways, and pavement.

B. Types of Portland Cement Concrete Paving:
   1. Concrete paving with standard gray color.

C. Cast-In-Place Detectable/Tactile Warning Tiles.

1.2 SUBMITTALS

A. Provide samples, manufacturer's product data, test reports, and materials' certifications for concrete, joint fillers, sealers, and colorants

B. Contractor to provide concrete mix design.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
   1. Use flexible spring steel forms or laminated boards to form radius bends as required.
   2. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

B. Reinforcing Bars: Deformed steel bars, ASTM A 615/A, 615M Grade 60.

C. Fly Ash, Class F: Fly ash, no more than 15% maximum replacing Portland Cement.

D. Fabricated Bar Mats: Welded or clip-assembled steel bar or rod mats, ASTM A 184. Use ASTM A 615, Grade 60 steel bars, unless otherwise indicated.

E. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

F. Metal Expansion Caps: Furnish for one end of each dowel bar in expansion joints. Design caps with one end closed and a minimum length of 3" to allow bars movement of not less than 1", unless otherwise indicated.

G. Hook Bolts: ASTM A 307, Grade A bolts, internally and externally threaded. Design hook bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

H. Concrete Materials: Comply with requirements of “Minor Concrete” as specified in State of California Department of Transportation Section 90 and Section 90-10.

I. Expansion Joint Materials: Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

J. Liquid-Membrane Forming and Sealing Curing Compound: Comply with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Moisture loss no more than 0.055 gr./sq. cm. when applied at 200 sq. ft. / gal.

K. Bonding Compound: Polyvinyl acetate or acrylic base, re-wettable type.

L. Epoxy Adhesive: ASTM C 881, 2-component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

M. Truncated domes: Cast in place type only meeting Americans with Disabilities Act (ADA): Provide detectable/tactile warning surfaces which comply with the detectable warnings on walking surfaces per section of the Americans with Disabilities Act (Title 49 CFR TRANSPORTATION, Part 37.9 STANDARDS FOR ACCESSIBLE TRANSPORTATION FACILITIES, Appendix A, Section 4.29.2 DETECTABLE WARNINGS ON WALKING SURFACES. In addition products must comply with CALIFORNIA TITLE 24 requirements regarding patterns, color and sound on cane contact.
   1. Color to be Yellow conforming to Federal Color No. 33538.
   2. Material to be Vitrified Polymer Composite (VPC).

2.2 CONCRETE MIX, DESIGN, AND TESTING

A. Comply with requirements of applicable Caltrans Std. Section 90-10 Minor Concrete, for concrete mix design, sampling and testing, and quality control and as herein specified.

B. Design mix to produce normal-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water-reducing admixture (super-plasticizer), air-entraining admixture, and water to produce the following properties:
   1. Compressive Strength: Strength selected for durability. Concrete is non-structural, and does not require special inspection.
      a. At 6" thick and thicker Traffic Slabs: 4000 psi, minimum at 28 days.
      b. At 4" thick and thicker Plaza and Sidewalks: 4000 psi, minimum at 28 days.
      c. At all other site concrete including curbs: 4000 psi, minimum at 28 days.
   2. In freeze-thaw areas add an air-entraining admixture to the concrete at the rate required to achieve an air content of 3-5 percent.

C.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Remove loose material from compacted subgrade and base surface immediately before placing concrete.

B. Proof-roll prepared subgrade and base surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION

A. Set forms to required grades and lines, braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork for grade and alignment to following tolerances:
1. Top of forms not more than 1/8 inch in 10 feet.
2. Vertical face on longitudinal axis, not more than 1/4 inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required ensuring separation from concrete without damage.

D. Slope step treads at 1/4 inch per foot maximum to drain.

3.3 REINFORCEMENT

A. Locate, place and support reinforcement as shown in the drawings. Reinforcement should be centered in concrete section unless shown otherwise.

3.4 TRUNCATED DOME INSTALLATION

A. Install cast in place truncated domes per manufacture’s recommended procedures.

3.5 CONCRETE PLACEMENT

A. General: Comply with requirements of Caltrans Std. Section 90-10 Minor Concrete for mixing and placing concrete, and as herein specified.

B. Do not place concrete until subgrade and base forms have been checked for line and grade. Moisten subgrade and base if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes, utility boxes or other structures until they are at required finish elevation and alignment.

C. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint

assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

D. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

E. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than ½ hour, place a construction joint.

F. When adjacent pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained sufficient strength to carry loads without damage.

G. Fabricated Bar Mats: Keep mats clean and free from excessive rust, and handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.
   1. Place concrete in 2 operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
   2. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.

H. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results that meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

3.6 JOINTS

A. General: Construct expansion, weakened-plane (contraction), and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

B. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

C. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows.
   1. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

D. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for more than ½ hour, except where such placements terminate at expansion joints.
   1. Construct joints as shown or, if not shown, use standard metal keyway-section forms.

2. Where load transfer-slip dowel devices are used, install so that one end of each dowel bar is free to move.

E. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.
1. Locate expansion joints at 40 feet O.C. typical unless otherwise indicated.

F. Extend joint fillers full width and depth of joint, not less than ½ inch or more than 1 inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

G. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.

H. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

I. Joint Sealants: Final sealant color to closely match adjacent concrete color. Sealant shall be an Elastomeric type specifically manufactured for long term concrete joint sealing. Preparation of joints, materials, and installation shall be per manufacturer's recommendations.

3.7 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10-ft. straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/4-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows:
1. Broom finish by drawing a fine-hair concrete broom across concrete surface perpendicular to line of traffic or in a swirl pattern as indicated on drawings. Repeat operation if required to provide a fine line texture acceptable to Architect.
2. On inclined slab surfaces and stairs, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.

E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.

3.8 CURING

A. Protect and cure finished concrete paving in compliance with applicable requirements of Caltrans std. section 90-10 Minor Concrete. Use membrane-forming curing and sealing compound or approved moist-curing methods.

B. Apply two coats of curing sealing compound per manufacturers recommendations. Apply so as to minimize glossy finish.

3.9 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, discolored or inconsistent colored concrete, concrete surfaces with an inconsistent texture, and concrete with improper or incomplete jointing as directed by Architect. Repair and replacement work shall be at no additional cost to 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 pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just before final inspection.

END OF SECTION 321313