

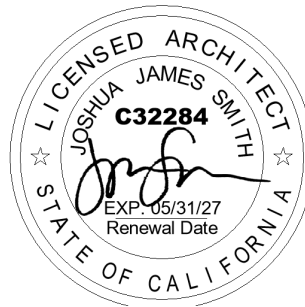
PROJECT MANUAL

Volume I of I

FILLMORE MIDDLE SCHOOL -HVAC REPLACEMENT FILLMORE UNIFIED SCHOOL DISTRICT

707 FIRST ST.
FILLMORE, CA 93015

DSA A#03-125539
WD Project # 25817



IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 03-125539 INC:
REVIEWED FOR
SS ☒ FLS ☒ ACS ☐
DATE: 03/27/2026

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SEALS PAGE
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**SECTION 00 40 00
PROCUREMENT FORMS AND SUPPLEMENTS**

PART 1 GENERAL

**1.01 CONTRACTOR IS RESPONSIBLE FOR OBTAINING A VALID LICENSE TO USE ALL
COPYRIGHTED DOCUMENTS SPECIFIED BUT NOT INCLUDED IN THE PROJECT MANUAL.**

1.02 FORMS

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the procurement requirements:
 - 1. Substitution Request Form
 - 2. Non-Collusion Affidavit
 - 3. Prevailing Wage
 - 4. Performance Bond
 - 5. Payment Bond
 - 6. Certificate of Contractor and Subcontractor Division of Industrial Relations Registration
 - 7. Information Required for Bidder
 - 8. List of Designated Subcontractors
 - 9. Certification of Financial Relationships in Regard to Window Project

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 00 73 10
DIVISION OF STATE ARCHITECT (DSA) SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.01 COMPLIANCE REQUIREMENTS

- A. Comply with the California Code of Regulations, Title 24, for parts 1 through 6 and 9.
 - 1. Title 24, parts 1 through 5 must be kept on site during construction.
- B. All addenda must be signed by Architect and approved by DSA per California Administrative Code (CAC) Section 4-338(b)
- C. All substitution affecting DSA regulated items shall be considered as a Construction Change Document (CCD) or Addenda and shall be approved by DSA prior to fabrication and installation. (CAC, Section 4-338(C), IR A-6
- D. Construction Change Documents must be signed by A/E of Record, Structural Engineer, delegated professional engineer (when applicable) and DSA
- E. Project Inspector and testing lab must be employed by the owner and approved by A/E of Record, Structural Engineer, and DSA.

1.02 EXISTING CONDITIONS

- A. The intent of these drawings and specifications is that the work of the alteration, rehabilitation or reconstruction is to be In accordance with title 24, CCR. 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 (CCD), or a separate set of plans and specifications, detailing and specifying the required work shall be submitted to and approved by DSA before proceeding with the work. (Section 4-317(C), part 1, title 24, CCR).

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

2.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment 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, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
- D. Limit each request to a single proposed substitution item.

2.02 RESOLUTION

2.03 ACCEPTANCE

END OF SECTION

**SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Contractor's daily reports.
- G. Progress photographs.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Requests for Interpretation (RFI) procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 60 00 - Product Requirements: General product requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.

4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Submission of initial Submittal schedule.
 6. Designation of personnel representing the parties to Contract, Fillmore USD and <1|A/E|>.
 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 8. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING

- A. Owner will schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- C. Agenda:
1. Use of premises by Owner and Contractor.
 2. Owner's requirements.
 3. Construction facilities and controls provided by Owner.
 4. Temporary utilities provided by Owner.
 5. Survey and building layout.
 6. Security and housekeeping procedures.
 7. Schedules.
 8. Application for payment procedures.
 9. Procedures for testing.
 10. Procedures for maintaining record documents.
 11. Requirements for start-up of equipment.
 12. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- D. Agenda:
1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Review of off-site fabrication and delivery schedules.

8. Maintenance of progress schedule.
 9. Corrective measures to regain projected schedules.
 10. Planned progress during succeeding work period.
 11. Coordination of projected progress.
 12. Maintenance of quality and work standards.
 13. Effect of proposed changes on progress schedule and coordination.
 14. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 32 16

- A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.05 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of work.
- D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 1. Delivery Medium: Via email.
 2. File Naming: Include project identification, date and time of view, and view identification.

3.06 REQUESTS FOR INTERPRETATION (RFI)

- A. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to Owner.
 3. Combine RFI and its attachments into a single PDF electronic file.
- B. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
- C. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- D. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- E. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 1. Highlight items requiring priority or expedited response.
- F. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 1. Response period may be shortened or lengthened for specific items, subject to the complexity of the RFI.
- G. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 2. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.07 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Coordinate with Contractor's construction schedule and schedule of values.
 2. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 3. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make

corrections or revisions to initial submittals, and time for their review.

3.08 SUBMITTALS FOR REVIEW

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

3.09 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.11 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Refer to Section 01 33 00 - Submittal Procedures

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

PART 1. - GENERAL

1.01 SUMMARY

- A. Submit to the Architect, progress schedule, application for payment, shop drawings, project data, and miscellaneous submittals required by the Contract Documents.
- B. Related Requirements Specified Elsewhere:
 - 1. General Conditions
 - 2. Supplementary Conditions
 - 3. Section 01 29 00 - Payment Procedures
- C. Designate in a progress schedule, or in a separate coordinated schedule, the dates for submission and the dates reviewed shop drawings, and project data will be needed for each product.

1.02 CONTRACTOR RESPONSIBILITIES

- A. Review shop drawings, and product data prior to submission. Provide review stamp on submittals. See Example "A" form at the end of this section and General Conditions for specific requirements
- B. Determine and Verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with specifications.
- C. Coordinate each submittal with requirements of the work and of the Contract documents.
- D. Notify the Architect in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not begin fabrication or work, which requires submittals until return of submittals with Architect's approval.

1.03 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that requires sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

1.04 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other contractor.
- B. Schedule submissions for the Architect to receive them at least 10 working days before dates reviewed submittals will be needed.
- C. Number of Submittals Required:
 - 1. Shop Drawings: Submit seven opaque prints.
 - 2. Product Data: Submit seven copies of manufacturer's product data.
- D. Accompany submittals with transmittal form provided by Architect, (sample provided at end of this section) in duplicate, containing:
 - 1. Date.

2. Project title and number.
 3. Contractor's name and address.
 4. The number of each shop drawing and product data submitted.
 5. Notification of deviations from Contract Documents.
 6. Other pertinent data.
- E. Submittals to include:
1. Date and revision dates.
 2. Project title and number.
 3. The names of:
 - a. Architect/Engineer.
 - b. Contractor.
 - c. Subcontractor.
 - d. Supplier.
 - e. Manufacturer.
 - f. Separate detailer when pertinent.
 4. Identification of product or material.
 5. Relation to adjacent materials.
 6. Field dimensions, clearly identified as such.
 7. Specification section number.
 8. Applicable standards, such as ASTM number or Federal Specification.
 9. A blank space, 8" x 3", for the Contractor and Architect stamps.
 10. Identification of deviations from Contract Documents.
 11. Contractor's stamp, signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents. Sample text of Contractors Review Stamp is provided at the end of this Section, identified as "Example 'A'."
- F. All items required to be submitted for review are to bear the review stamp of the Contractor certifying that he has reviewed the content of the submittal, that the submittal complies with the Contract Documents and contains no unauthorized substitutions.
- G. The Architect reserves the right to reject and return, unreviewed, all submittals not bearing the review stamp of the Contractor; poor quality or incomplete Shop Drawings and all submittal which do not meet the requirements of this Section and General Conditions Article 23, Shop Drawings, Product Data, and Samples. Construction delays resulting from returned, incomplete or incorrect submittals are the responsibility of the Contractor and not the Architect

1.05 RESUBMISSION REQUIREMENTS

- A. Shop Drawings:
1. Revise initial drawings as required and resubmit as specified for initial submittal.
 2. Indicate on drawings any changes, which have been made other than those, requested by Architect.
 3. Product Data: Submit new data as required for initial submittal.

1.06 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Critical-Path Schedule: Prepare a fully developed, Critical Path Method type Contractor's construction schedule. Submit within 7 days after the date established for "Award of Contract". Submit Schedule in compliance with General Conditions Article 32, Progress Schedule.
1. Provide a separate time 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 indicated in the "Schedule of Values".
 2. Within each time period indicate estimated completion percentage in 10 percent increments. As Work progresses, indicate Actual Completion.
 3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
 4. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other

schedules.

5. 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.

1.07 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
 1. Dimensions.
 2. Identification of products and materials included.
 3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
 6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2" x 11" but no larger than 30" x 42".
 - a. One of the prints returned shall be marked-up and maintained as a "Record Document".
 7. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
- C. Number of copies submittals:
 1. Electronic document submittals:
 - a. Small sheet (8-1/2" x 11" and 11" x 17"), submit electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
 2. Hard copy submittals:
 - a. Large sheet, not larger than 30" x 42": submit 3 copies. One to be returned to the contractor for contractors use and reproduction, with other copies retained by architect and architects consultant.

1.08 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."
 1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information. Delete information, which is not applicable.
 2. Submittals: Submit 2 copies of each required submittal; submit 4 copies where required for maintenance manuals. The Architect will retain one, and will return the other marked with action taken and corrections or modifications required.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 3. Distribution: Furnish copies of approved submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - a. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession. Do not permit use of unmarked copies of Product Data in connection with construction.

1.09 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.
 - 1. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's Sample. Include the following:
 - a. Generic description of the Sample.
 - b. Sample source.
 - c. Product name or name of manufacturer.
 - d. Compliance with recognized standards.
 - e. Availability and delivery time.
 - 2. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
 - b. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.
 - 3. Preliminary submittals: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
 - 4. Maintain sets of Samples, as returned, at the Project site, for quality comparisons throughout the course of construction.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal. Sample sets may be used to obtain final acceptance of the construction associated with each set.
 - 5. Field Samples specified in individual Sections are special types of Samples. Field Samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.
 - a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.10 ARCHITECT'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.
 - 1. Compliance with specified characteristics is the Contractor's responsibility.

1.11 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

- A. Contractor is to distribute reproductions of Shop Drawings and copies of Product Data which carry the Architect/Engineer stamp to:
 - 1. Job site file.
 - 2. Record Documents file.
 - 3. Other affected contractors.
 - 4. Subcontractors.
 - 5. Supplier or Fabricator.
 - 6. Owner's Inspector.

1.12 TIMING OF SUBMITTALS

- A. Make submittals far enough in advance of scheduled dates for installation to provide the required time for reviews, for securing necessary approvals of DSA if required, for possible revision and resubmittals, for placing orders and securing delivery.

- B. Delays: Cost of delays occasioned by tardiness of Contractor submittals may be back charged as necessary and is not to be borne by the School District or Architect.

PART 2. PRODUCTS

NOT APPLICABLE

PART 3. EXECUTION

NOT APPLICABLE

END OF SECTION

**SECTION 01 40 00
QUALITY CONTROL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General Quality Assurance.
 - 1. Workmanship.
 - 2. Tolerances
 - a. References.
 - b. Mockup.
 - c. Manufacturers' Field Services and Reports.
- B. RELATED SECTIONS
 - 1. Section 01 30 00 - Administrative Requirements
 - 2. Section 01 41 00 - Testing and Inspections.
 - a. Section 01 25 00 - Substitution Procedures
 - b. Section 01 65 00 - Starting of Systems.
- C. WORKMANSHIP
 - 1. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
 - a. Comply with manufacturers' instructions, in full detail, including each step in sequence.
 - b. Should manufacturers' instructions conflict with Project Documents, request clarification from Architect before proceeding.
 - c. 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.
 - d. Perform work by persons qualified to produce workmanship of specified quality.
 - e. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
- D. 1.4 TOLERANCES
- E. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate to result in unacceptable field conditions.
 - 1. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Project Documents, request clarification from Architect before proceeding.
 - 2. Adjust Products to appropriate dimensions; position before securing Products in place.
- F. MOCK-UP
 - 1. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
 - 2. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
 - 3. Accepted mock-ups shall be representative of the quality required for the Work.
 - a. here mock-up has been accepted by Architect and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.
- G. MANUFACTURERS' FIELD SERVICES AND REPORTS
 - 1. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
 - a. Manufacturers' representative shall be subject to approval of Architect.
 - b. Manufacturers' representative shall submit a written report of observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

- c. Submit report in duplicate within 30 days of observation to Architect for information.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

**SECTION 01 41 00
TESTING AND INSPECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selection and payment.
- B. Contractor submittals.
- C. Laboratory responsibilities.
- D. Laboratory reports.
- E. Limits on testing laboratory authority.
- F. Contractor responsibilities.
- G. Schedule of tests and inspections.

1.02 RELATED SECTIONS

- A. Information For Bidders
- B. General Conditions: Inspections, testing, and approvals required by public authorities.
- C. Section 01 33 00 - Submittals: Manufacturer's certificates.
- D. Section 01 65 00 - Starting of Systems
- E. Section 01 70 00 - Contract Closeout: 1.08 Project Record Documents.
- F. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.03 REFERENCES

- A. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete.
- B. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
- C. ASTM C88 - Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
- D. ASTM C140 - Sampling and Testing Concrete Masonry Units.
- E. ASTM C426 - Standard Test Method for Drying Shrinkage of Concrete Block.
- F. ASTM D1556 - Standard Test for Density of Soil in Place by the Sand-Cone Method.
- G. AWS D1.1 - Structural Welding Code - Steel.
- H. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- I. T24, CCR - Title 24, California Code of Regulations.
- J. CBC - California Building Code, Volume II - Standards

1.04 SELECTION AND PAYMENT

- A. Owner will employ and pay for services of an independent testing laboratory to perform specified testing and review and comment upon welding procedures. Owner will employ and pay for services of a DSA certified inspector to perform specified inspections. The Contractor shall not pay for any laboratory testing or inspections to testing laboratory or inspector.
- B. Testing Laboratory and inspector will be approved by the Division of the State Architect, per T24, CCR, Part I, Section 4-335. Testing lab must have DSA LEA acceptance.
- C. Employment of testing laboratory in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Costs of initial testing and inspection, except as specifically modified herein, or specified otherwise in technical sections, will be paid for by the District, providing such testing and inspection indicates compliance with Contract Documents. Initial tests and inspections are defined as the first tests and inspections as hereinafter specified. The District may be reimbursed by the Contractor for testing costs under the Contract conditions contained herein, and in the General Conditions.

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- E. In the event a test or inspection indicates failure of a material or procedure to meet requirements of Contract Documents, costs for re-testing and re-inspection will be paid by the District and deducted from payments to Contractor.
- F. Additional tests and inspections not herein specified but requested by District or Architect, will be paid for by the District, unless results of such tests and inspections indicate non-compliance with Contract Documents, in which case the District will pay all costs for initial testing as well as re-testing and re-inspection and deduct such costs from payments to Contractor.
- G. Costs for additional tests or inspections required because of change in materials being provided or change of source or supply will be paid by District and deducted from payments to the Contractor.
- H. Costs for work required to correct deficiencies shall be borne by the Contractor.
- I. Cost of testing, which is required solely for the convenience of Contractor in his scheduling and performance of work, shall be borne by the Contractor. Overtime costs shall be borne by the Contractor when work is performed during hours other than normal workweek and laboratory inspection is required. District will pay normal cost of laboratory inspection, and Contractor shall pay that portion of laboratory inspection cost due to overtime.
- J. Testing Laboratory will separate and identify on the invoices, the costs covering all testing and inspections that are to be deducted from payments to the Contractor, as specified above.
- K. Testing Laboratory will furnish to District a cost estimate breakdown covering initial tests and inspections required by Contract Documents. Estimate will include number of tests, man-hours required for tests, field and plant inspections, travel time and costs.
- L. The cost of shop fabrication inspection and material testing outside the State of California or outside of a 150-mile radius of the job site shall be paid for by the District and deducted from payments to the Contractor.

1.05 TESTING LABORATORY

- A. Testing and inspection services shall be performed by an independent testing laboratory, and shall be in accordance with requirements of Title 24, CCR, and the requirements specified herein. The duties of the Testing service are described in T24, CCR, Part I, Article 4-335.
- B. Testing and inspection services shall verify that work incorporated into the project meets the requirements of the Contract Documents.
- C. In general, tests and inspections for structural materials shall include all items listed on the Structural Tests and Inspections list for this project as prepared and distributed by the Architect, and approved by the Division of the State Architect.
- D. Test reports shall be signed by a Registered Civil Engineer licensed in the State of California.

1.06 TESTS

- A. Selection of the material to be tested shall be by the laboratory or the District's representative and not by the Contractor.
- B. The Contractor shall notify the District's representative a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must by terms of the Contract be tested, in order that the District may arrange for the testing of same at the source of supply.
- C. Any material shipped by the Contractor from the source of supply before having satisfactorily passed such testing and inspection or before the receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated in the job.

1.07 TEST AND INSPECTION REPORTS

- A. Testing Laboratory will certify in writing that all work specified or required to be tested and inspected conforms to or does not conform to drawings, specifications and applicable building codes.

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- B. The Testing Laboratory will make the following distribution of all test and inspections reports within 14 days of the date of the test:
- | | |
|---|---|
| 1. Project Inspector of Record | 1 |
| 2. Specialty Inspectors | 1 |
| 3. Architect | 2 |
| 4. Structural Engineer | 1 |
| 5. Contractor | 1 |
| 6. School District/Construction Manager | 2 |
| 7. Division of the State Architect | 1 |
- C. One copy of all test reports shall be forwarded to the Division of the State Architect within 14 days of the date of the test by the testing agency. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory.
1. Samples taken but not tested shall also be reported.
 2. Records of special sampling operations as required shall also be reported.
 3. The reports shall indicate that the material or materials were sampled and tested in accordance with the requirements of T24, CCR and with the approved specifications.
 4. Test reports shall show the specified design strength.
 5. Test reports shall also state definitely whether or not the material or materials tested comply with requirements.

1.08 VERIFICATION OF TEST REPORTS

- A. Each testing agency shall submit to the Division of the State Architect a verified report in duplicate covering all of the tests which are required to be made by that agency during the progress of the project. Such report shall be furnished each time that work on that project is suspended, covering the tests up to that time, and at the completion of the project, covering all tests.

1.09 REPORTING TEST FAILURES

- A. Immediately upon Testing Laboratory determination of a test failure, the Laboratory will telephone the results of test to Architect. On the same day, Laboratory will send written test results to those named on above distribution list.

1.10 AVAILABILITY OF SAMPLES

- A. Contractor shall make materials required for testing available to Laboratory and assist in acquiring these materials as directed by the District's Inspector. The samples shall be taken under the immediate direction and supervision of the Testing Laboratory.
- B. If work, which is required to be tested or inspected, is covered up without prior notice or approval, such work may be uncovered at the discretion of Architect at no additional cost to the District. Refer to Article 1.04 of this section.
- C. Unless otherwise specified, Contractor shall notify Testing Laboratory a minimum of three working days in advance of all required tests, and a minimum of three working days in advance of all required inspections. Extra laboratory expenses resulting from failure to notify the Laboratory shall be paid for by the District and deducted from payments to the Contractor.
- D. Contractor shall give sufficient advance notice to Testing Laboratory in the event of cancellation or time extension of a scheduled test or inspection. Charges due to insufficient advance notice of cancellations or time extensions shall be paid for by the District and deducted from payments to the Contractor.

1.11 REMOVAL OF MATERIALS

- A. Unless otherwise directed, materials not conforming to the requirements of Contract Documents shall be promptly removed from the job site.

1.12 INSPECTION BY THE DISTRICT

- A. The District and his representatives shall at all times have access for the purpose of inspection to all parts of the work and to the shops wherein the work is in preparation, and the Contractor

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shall at all times maintain proper facilities and provide safe access for such inspection.

- B. B. The District shall have the right to reject materials and workmanship that are defective, or to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the District. If the Contractor does not correct such rejected work within a reasonable time, fixed by written notice, the District may correct such conditions and deduct the costs from payments to the Contractor.
- C. Should it be considered necessary or advisable by the District at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out the same, the Contractor shall on request promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any respect due to fault of the Contractor or his subcontractor, the Contractor shall bear the expense of such examinations and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the additional cost of labor and material necessarily involved in the examination and replacement shall be reimbursed to the Contractor by the District.

1.13 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
- B. Verify that all required examinations and test samples have been made prior to covering work.
- C. Provide incidental labor and facilities:
 - 1. To provide access to Work to be tested,
 - 2. To obtain and handle samples at the site or at source of Products to be tested,
 - 3. To facilitate tests and inspections,
 - 4. To provide storage and curing of test samples.

1.14 DISTRICT'S INSPECTOR

- A. A DSA Certified Inspector employed by the District in accordance with the requirements of T24, CCR, will be assigned to the work. The duties of the Inspector are described in T24, CCR, Part I, Article 4-333 & Article 4-342.
- B. Special Inspectors may be employed by the District as required by T24, CCR. They shall be afforded every right of access and cooperation required of the Contractor for the Inspector of Record.
- C. The work of construction in all stages of progress shall be subject to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the work at any time. The Contractor shall furnish the Inspector reasonable facilities for obtaining the information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the work shall not relieve the Contractor from any obligation to fulfill this Contract.
- D. Contractor shall keep Inspector advised at all times of all work in advance of its execution. Such advance notice shall be in conformance with the time limitations established in the project manual and CCR, T24. The minimum notice shall be 24 hours in advance of performance of the work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULE OF TESTS AND INSPECTIONS

- A. Provide reference to the approved DSA 103 for complete listing structural test and special inspections.
- B. Tests and inspections for the following will be required, as applicable. Section references are to T24 CCR, Part 2. Refer to DSA 103-22 for the for list of structural tests and special inspections.

END OF SECTION

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SECTION 01 50 00
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone service, water, and sanitary facilities.
- B. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone service, water, and sanitary facilities.
- C. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.
- D. Construction Facilities: Access roads, parking, progress cleaning, project signage, and temporary buildings.
- E. Furnish and install all required temporary facilities as indicated or specified herein plus such facilities for proper performance of the Contract. All such temporary facilities shall be located where directed and maintained in a safe and sanitary condition at all times until completion of the Contract. Other sections of Division 1 apply to this section as fully as if repeated herein.

1.02 REGULATORY REQUIREMENTS (ALL WORK TO BE IN COMPLIANCE WITH CFC CH. 33 - FIRE SAFETY DURING CONSTRUCTION AND DEMOLITION)

- A. Comply with governing regulations and utility company regulations and recommendations.
- B. Comply with pollution and environmental protection regulations for use of water and energy, for discharge of waste and storm drainage from project site, and for control of dust, air pollution and noise.
- C. Temporary work shall conform to requirements of State, County, and local authorities and underwriters which pertain to operation, health, safety, and fire hazard. Contractor shall furnish and install items necessary for conformance with such requirements, whether or not called for under separate division of these specifications. Comply with 2022 California Fire Code Chapter 33 during all phases of project.
- D. The Contractor shall send proper notices, make all necessary arrangements and perform all other services required in the care and maintenance of all public utilities. The Contractor shall assume all responsibility concerning the same for which the Owner may be liable.
- E. Enclosing or boxing in, for protection of any public utilities equipment, shall be done by the Contractor. Upon completion of the work, the Contractor shall remove all enclosures, fill in all openings in concrete and masonry, and grout the same watertight, and leave in a finished condition.

1.03 TEMPORARY ELECTRICITY

- A. Provide temporary electric feeder from existing building or pole electrical service at location as determined. Do not disrupt Owner's need for continuous service. Owner shall determine closest availability of power.
- B. B. Complement existing power service capacity and characteristics as required.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor and as required. Provide flexible power cords as required.
- D. Provide main service disconnect and overcurrent protection at convenient location.
- E. Permanent convenience receptacles may not be utilized during construction.
- F. Provide adequate distribution equipment, wiring, and outlets to provide single-phase branch circuits for power and lighting.
 - 1. Provide 20 ampere duplex outlets, single-phase circuits for power tools.
 - 2. Provide 20 ampere, single-phase branch circuits for lighting.

1.04 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2-watt/sq ft.
- B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- D. Maintain lighting and provide routine repairs.
- E. Permanent building lighting may be utilized during construction.

1.05 TEMPORARY HEAT

- A. Existing facilities shall not be used.
- B. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Provide all temporary heat as necessary for the drying of the building, the proper installation of all work and materials, and the protection of all work and materials against injury from dampness and cold. The permanent building heating system shall not be used for any temporary heating unless first approved by the District. If approved for use, filters shall be replaced before final acceptance of work.

1.06 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, to prevent accumulation of fungus, mold, dust, fumes, vapors, or gases, and to cure materials.

1.07 TELEPHONE SERVICE

- A. Provide, maintain and pay for telephone service to a designated Contractor's representative who shall be available to answer all calls 24 hours a day, 7 days a week (representative shall be on-call at all times), for emergencies or other communications regarding the project. Telephone service that is monitored only during normal working hours is not acceptable.

1.08 TEMPORARY WATER SERVICE

- A. Provide, maintain and pay for suitable quality water service required for construction operations.
- B. Provide separate metering and reimburse Owner for cost of water used.
- C. Extend branch piping with outlets located so water is available by hoses with threaded connections.
- D. Make arrangements and pay all costs for all water required for construction purposes and for testing, disinfection and flushing of the water supply system. Furnish and install piping or hose to carry water to every point where needed on the project. All water used on the project shall be potable water. The Contractor shall determine closest availability of water.
- E. Provide fire protection for the duration of work in accordance with local codes, ordinances and the State Fire Marshall.
 - 1. The Contractor shall take necessary precaution to guard against and eliminate possible fire hazards and to prevent damage to construction work, building materials, equipment, and public property. The Contractor shall be responsible for providing, maintaining and enforcing fire protection methods.

1.09 TEMPORARY SANITARY FACILITIES

- A. Provide sanitary temporary toilet facilities in no fewer numbers than required by law and such additional facilities as may be directed by the Inspector for the use of all workers. The toilet facilities shall be maintained in a sanitary condition at all times and shall be left at the site until

removal is directed by the Inspector. Use of toilet facilities in the work under construction shall not be permitted.

1.10 BARRIERS AND BARRICADES

- A. Provide barriers and barricades to prevent unauthorized entry to construction areas and to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barriers, barricades and covered walkways as required by governing authorities for public rights-of-way and for public access to new and existing buildings.
- C. Provide protection for plant life designated to remain. Replace damaged plant life to match existing.
- D. Protect non-owned vehicular traffic, stored materials, site, structures, walks, drives and curbs from damage.
- E. Barricades shall be a panelized system, commercial grade chain link fence with vision screen fabric, or approved equal.
- F. Provide 8-foot high barricade around construction site and staging area. Equip with vehicular and pedestrian gates with locks.
- G. Barricades shall include, but not be limited to, that shown on the drawings when so indicated. Additional fencing may be required to secure the work area and direct users of the site to other areas.
- H. When the project is phased or portioned, the construction barricade associated with that work shall be removed upon completion of that phase or portion and construction barricade provided to properly contain the area still under construction.

1.11 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from ponding or concentrated water flow. Provide water barriers as required to protect site from soil erosion.

1.12 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- B. Provide temporary roofing as required to protect work.

1.13 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.
- G. Restore staging area to match pre-construction conditions. Sod, fertilize and maintain turf for 30 days after final acceptance. Re-establish sprinkler systems to full working order.

1.14 SECURITY

- A. Provide security and facilities to protect Work, and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.15 ACCESS ROADS

- A. Maintain temporary roads accessing public thoroughfares to serve construction area.
- B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
- C. Provide and maintain access to fire hydrants, free of obstructions. Maintain access to fire roads.
- D. Provide means of removing mud from vehicle wheels before entering streets.

1.16 PARKING

- A. Arrange for temporary surface parking areas to accommodate construction personnel.
- B. When site space is not adequate, provide additional off-site parking.
- C. Do not allow vehicle parking on existing pavement without Owner's written approval.
- D. Coordinate street access and possible partial use of street with City.

1.17 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.
- E. Open free-fall chutes not permitted. Terminate closed chutes into appropriate containers with lids.

1.18 PROJECT IDENTIFICATION

- A. Provide a Project Sign, erected on site at a location directed by the Architect.
- B. Project Sign shall be constructed as follows:
 - 1. Supported by wood posts set in secure footings, post and footing size as required to comply with Code and provide for safety, posts painted black.
 - 2. Sign panel constructed of two sheets of 5/8" MDO plywood. Sign panel not less than 4' x 8' and not greater than 8' x 12', size as required to accommodate text and spacing. Set with bottom of panel 3' - 0" above grade, and secured to posts with 3/8" lag screws. Plywood painted white, all sides and edges, primer and two finish coats.
 - 3. Lettering done by a professional sign painter.
 - a. List title of Project, name of Owner, members of Governing Board, school district administrators, Architect, Contractor, source of funding, and other information as directed by Architect.
 - b. Text color: Black
 - c. Text style: Helvetica Medium
 - d. Text Size:

Project Name: 4"

Project Funding Source: 3"

Owner Name: 4"

overning Board, Architect, Contractor Titles: 3"

Governing Board, Architect, Contractor Names: 2"

- e. Text weight: As provided by Architect
- f. Text content: As provided by Architect
- C. Provide shop drawings for approval. Do not construct Project Sign without Architect's approval of shop drawings.
- D. Renew project sign every 6 months of project duration. Original sign may remain without replacement if it is maintained in good condition, and upon acceptance of Owner.
- E. Renew project sign every 6 months of project duration. Original sign may remain without replacement if it is maintained in good condition, and upon acceptance of Owner.

1.19 FIELD OFFICES

- A. Provide on-site, adequate field construction office space for use by construction forces, the District Inspector, and the Architect during the time construction is in progress. The offices shall be conveniently located and shall be watertight and waterproof, clean, insulated, heated, cooled, lockable, provided with windows to give adequate light and ventilation, have electrical service outlets, and have a floor. Minimum size of temporary site construction is 360 square feet.
 - 1. Equip with a minimum of one desk and a layout table. Equip with additional folding chairs for field meetings.
 - 2. The offices, equipment, and furniture shall remain the property of the Contractor and shall be removed by contractor upon completion of work.
 - 3. A complete set of approved plans and specifications shall be kept in the office at all times.
- B. Inspectors Field Office: Contractor is required to provide for the use of the School District's Inspector a temporary office space to be located as directed by the Inspector and to be maintained until removal is authorized by the School District. Space is to have a lockable separate room area with a table for plans and a desk with two chairs. At least one entrance to Inspector office space is to be from the outside and not through the Contractors field office space. Maintain for Inspector until completion of the Contract.

1.20 CONSTRUCTION EQUIPMENT

- A. Contractor shall erect, equip, and maintain construction equipment in strict accordance with applicable statutes, laws, ordinances, rules and regulations of authority having jurisdiction.
- B. Contractor shall design, obtain agency approvals, provide, maintain and remove upon completion of the work all temporary bracing, shoring, rigging, scaffolding, hoisting equipment, rubbish chutes, ramps, stairs, runways, platforms, ladders, railings, and other temporary work as required for all work hereunder.

1.21 STORAGE

- A. Operations of the Contractor, including storage of materials shall be confined to areas approved. Contractor shall be liable for damage caused by him during such use of property of the District or other parties. Contractor shall save the District, its officers and agents, and the Architect and his employees free and harmless from liability of any nature or kind arising from any use, trespass, or damage occasioned by his operations on premises of third persons. Storage facilities shall provide protection of products from excessive cold, heat, moisture, humidity or physical abuse as specified in the respective sections for the products stored.

1.22 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.23 PROJECT ACCESS

- A. See Special Conditions, Section 01000 for restrictions placed upon access to the Project.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1. - GENERAL

SECTION INCLUDES

2.01 THIS SECTION ESTABLISHES PROCEDURES FOR SPECIFIED PRODUCT OPTIONS.

- A. . The intent of this section is to ensure that specified product options exceed or equal the quality of the specified products and are furnished and installed in accordance with the design intent.
- B. RELATED SECTIONS
 - 1. General and Supplementary Conditions
 - a. Section 01 30 00 - Administrative Requirements
 - b. Section 01 25 00 - Product Substitution Procedures
 - c. PRODUCT OPTIONS
 - 2. Where product options are included in the specifications sections and are specified by naming more than one, or several acceptable products or manufacturers, select any product or manufacturer listed.
 - 3. Where more than one manufacturer or product is listed in the specifications and only one manufacturer or product is specified in detail with model numbers and features, the one specified in detail shall be considered the standard of quality required for all manufacturers or products listed.
 - a. Where product options are included in the specifications and they are followed by an "or equal " or "approved equal" or equal meeting a specified standard, review and approval by the Architect and School District is required for Contractor proposed equal items. Procedures specified in Section 01630 are to be followed.
 - b. For items specified only by Reference Standards, select any item meeting standards.
 - c. Performance Specifications: For items specified by performance requirements, select any item meeting the performance standards specified.
 - d. Descriptive Specifications: When specifications describe a product or assembly, listing exact components and characteristics, without the use of a brand or trade name, provide a product or assembly that contains the components and characteristics specified.
 - 1) Compliance with Standards Specifications: When specifications only require compliance with a Code, Regulation or Voluntary Standard, Provide products that comply with the specified Codes, Regulations or Standards.
 - 2) Submit request, as required for substitution, for any item or manufacturer not specifically named in the specifications on the Substitution Request Form enclosed with the Bidding Documents.
 - 3) 1. Architect and School District will determine acceptability of proposed substitutions.

PART 2. - PRODUCTS

3.01 NOT APPLICABLE

PART 3. - EXECUTION

NOT APPLICABLE

END OF SECTION

**SECTION 01 63 00
PRODUCT SUBSTITUTION PROCEDURES**

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. This Section establishes procedures for Contractor submittal of substitutions.
- B. This Section provides procedures for review and compliance with Public Contract Code Section 3400 for the "or equal" clause allowing bidders to furnish any equal material, product, thing or service. Or equal items proposed by bidders are considered substitutions and are subject to approval of the Architect and School District. Burden of proof for "Or Equals is the responsibility of the Contractor.
- C. The intent of this section is to insure that proposed substitutions exceed or equal the quality of the specified products and are furnished and installed in accordance with the Contract Documents.

1.02 RELATED SECTIONS

- A. General and Supplementary Conditions
- B. Section 01 60 00 - Product Requirements

1.03 SUBSTITUTIONS

- A. Substitution requests are to be submitted by General Contractors only. Requests submitted by Subcontractors, Material Suppliers, Manufacturers and other interested parties, other than General Contractors, will not be considered. Submit requests on the attached FORM "A", SUBSTITUTION REQUEST FORM at the end of this section.
- B. Comply with provisions of Articles for Substitutions in the General Conditions and any modifications to General Conditions provided in the Supplementary Conditions.
- C. Tabulate products by specification section number and title.
- D. Submit separate request for each substitution. In addition to "FORM A", SUBSTITUTION REQUEST FORM", support each request with a side by side itemized comparison of the proposed substitution with product specified; including significant variations. Substitution requests without side by side itemized comparisons will not be reviewed, not accepted. Support each request with:
 - 1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - 1) Product description.
 - 2) Reference standards.
 - 3) Performance and test data.
 - 4) Fire resistance and fire ratings.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
 - 2. List significant variations.
 - 3. Any effect the substitution may have on other trade contracts.
 - 4. List of changes required in other work or products.
 - 5. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any change in cost.
 - 6. Designation of required license fees or royalties.
 - 7. Designation of availability of maintenance services, sources of replacement materials.
 - 8. Comparison of physical size and weight with product specified.
 - 9. Comparison of physical shape and available finishes.
- E. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals and where not approved in compliance with the General Conditions and this section.
 2. They are requested after the Contract has been executed.
 3. Substitution request procedures included in this Section and in the General and Supplementary Conditions are not complied with by the Contractor.
 4. The School District has determined that compatibility, standardization, technological sophistication, service and uniformity are necessary with regard to technological and certain safety items across the Schools in the District.
- F. Substitute products shall not be installed in the construction without written acceptance of the Architect and School District.
- G. Architect and School District will determine acceptability of proposed substitutions prior to awarding of the Contract. Substitutions may be approved after award of the contract only where the following conditions exist.
1. Specified item has been discontinued or is not unavailable to meet project schedule.
 2. The School District requested the Substitution.
 3. Substitution will reduce the Contract Amount and Contract Time (Credit Back to the District) without reducing quality.

1.04 CONTRACTOR'S SUBSTITUTION CERTIFICATION

- A. In making formal request for substitution contractor certifies that:
1. He has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.
 2. He will provide same warranties or bonds for substitution as for product specified.
 3. He will coordinate installation of accepted substitution into the work, and will make such changes as may be required for the work to be complete in all respects including modification of the work of other trades.
 4. He waives claims for additional costs caused by substitution which may subsequently become apparent.
 5. Substituted material is similar in physical appearance, size and weight and will install with the same opening and attachments.
 6. Substituted material has the same or better fire rating and fire resistive qualities, including flame spread, smoke developed, UL tested and listing.

1.05 ARCHITECT'S DUTIES

- A. Review contractor's request for substitutions with reasonable promptness.
- B. Consult with District and provide notification to contractor, in writing, of decision to accept or reject requested substitution.

1.06 AVAILABILITY OF SPECIFIED ITEMS

- A. Verify prior to bidding that all specified and substituted items will be available in time for installation during orderly and timely progress of the work.
- B. In the event specified items will not be available, notify the Architect prior to receipt of bids.
- C. Cost of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Architect or School District.

1.07 SUBSTITUTION WARRANTY REQUIREMENTS

- A. The Contractor is to warrant, in writing, that the substituted items are to perform as specified, and assume complete responsibility for the same. This includes responsibility and costs required for modifications to building, other materials, or equipment, and any additional coordination with work of other trades. Testing, of Substitution proposed, if required or requested by the Architect or School District shall be paid for by the Contractor.

PART 2. PRODUCTS
NOT APPLICABLE
PART 3. EXECUTION
NOT APPLICABLE

END OF SECTION

**SECTION 01 65 00
STARTING OF SYSTEMS**

PART 1 GENERAL

SECTION INCLUDES

2.01 STARTING SYSTEMS.

- A. Demonstration and instructions.
- B. Testing, adjusting, and balancing.
- C. RELATED SECTIONS
 - 1. Section 01 40 00 - Quality Control: Manufacturers field reports.
 - a. Section 01 70 00 - Execution and Closeout Requirements: System operation and maintenance data and extra materials.
- D. STARTING SYSTEMS
 - 1. Coordinate schedule for start-up of various equipment and systems.
 - a. Notify Architect and Owner seven days prior to start-up of each item.
 - b. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
 - c. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
 - d. Verify wiring and support components for equipment are complete and tested.
 - e. Execute start-up under supervision of applicable manufacturer's representative or Contractors' personnel in accordance with manufacturers' instructions.
 - f. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
 - g. Submit a written report in accordance with Section 01400 that equipment or system has been properly installed and is functioning correctly.
- E. DEMONSTRATION AND INSTRUCTIONS
 - 1. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.
 - a. Demonstrate Project equipment and instruct in a classroom environment located at Owner's premises and instructed by a qualified manufacturers' representative who is knowledgeable about the equipment.
 - 1) C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
 - 2) Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
 - 3) Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time at equipment location.
 - 4) Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
 - b. The amount of time required for instruction on each item of equipment and system is that specified in individual sections. Allow additional time as required to ensure Owner's representative understands all aspects of operation.
 - c. TESTING, ADJUSTING, AND BALANCING
 - d. Owner will appoint and employ services of an independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services.
 - e. The independent firm will perform services specified in Division 15.

- f. Reports will be submitted by the independent firm to the Architect indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.

PART 2 PRODUCTS

3.01 NOT USED

PART 3 EXECUTION

4.01 NOT USED

END OF SECTION

**SECTION 01 70 00
CONTRACT CLOSEOUT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Closeout Procedures.
- B. Final Cleaning.
- C. Adjusting.
- D. Final Inspections
- E. Project Record Documents.
- F. Operation and Maintenance Data.
- G. Warranties.
- H. Spare Parts and Maintenance Materials.

1.02 RELATED SECTIONS

- A. General Conditions
- B. Section 01 50 00 - Construction Facilities and Temporary Controls: Progress cleaning.
- C. Section 01 65 00 - Starting of Systems: System start-up, testing, adjusting, and balancing.

1.03 CLOSEOUT PROCEDURES

- A. When work is complete, submit written certification that Project Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Project Documents and ready for Inspector, District, and Architect review. Certification shall request final inspection by District.
- B. Submit the following:
 - 1. Division of the State Architect, Verified Report, DSA-6, to the Architect, in duplicate.
 - 2. Close-out submittals as required by State and local agencies.
 - 3. Close-out submittals as required in individual specification sections.
 - 4. Completed Record Drawings.
 - 5. Guarantee: Division 0
- C. Owner may occupy portions of the Work prior to its completion by the Contractor.

1.04 REQUIREMENTS PREPARATORY TO COMPLETION

- A. All temporary facilities shall be removed from the site as specified in Section 01500.
- B. The buildings and site shall be thoroughly cleaned as specified in this Section.
- C. All plumbing and mechanical equipment shall operate quietly and free from vibration. Properly adjust, repair, balance, or replace equipment producing objectionable noise or vibration. Provide additional brackets, bracing, water hammer arrestors, or other methods to prevent objectionable noise or vibration. All systems shall operate without humming, surging, or rapid cycling.
- D. All operating instructions for equipment shall be properly mounted and posted as specified in their respective sections.
- E. Record (As-built) drawings shall be completed, signed, endorsed by the Inspector, and submitted to the Architect as specified herein.
- F. The Material and Equipment maintenance instructions, as specified in the body of the Specifications, shall be submitted to the Architect.
- G. All guarantees and warranties shall be submitted to the Architect.
- H. All tools, which are a permanent part of equipment installed in the Work, shall be delivered to the District.

- I. All keys, construction and permanent, properly identified shall be delivered to the District.
- J. Contractor shall make final gas, water, waste, vent and electrical connections.

1.05 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment. Employ skilled workmen experienced in cleaning construction materials.
- B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Replace filters of mechanical equipment and any other filter installations performed as a part of the work.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- H. Wash and shine glazing and mirrors.
- I. Polish glossy surfaces to a clear shine.
- J. Vacuum all carpet.
- K. Dust and damp mop all tile and resilient flooring.

1.06 ADJUSTING

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

1.07 OBSERVATION OF COMPLETED WORK

- A. When the Work is complete, and after all requirements preparatory to Completion have been performed as herein specified, Contractor shall notify the Architect in writing.
- B. When requested by the District or Architect, the Contractor (and subcontractors as required by District or Architect), shall accompany the District and/or Architect on a tour of the Work.
- C. If corrective work is identified, the Contractor may be provided with a "punch-list" identifying work that is incomplete and/or in need of correction. A "punch-list" shall not relieve the Contractor of any requirement of the Project Documents, nor shall such a list be considered to be all-inclusive of remaining work. The Contractor is responsible for completing all work required by the Project Documents, including all incomplete and corrective work, within the time requirements of the Contract.
- D. If a "punch-list" or other notice of correction is issued to the Contractor, Contractor shall notify the Architect in writing, when all such work is complete. Contractor shall include with the written notification, a copy of all punch-lists issued to him. Each punch-list item shall be annotated with the construction superintendent's initials, and the date that the item was observed by him to have been completed. The Contractor shall reimburse all costs incurred by the District, Architect, or Architect's consultants, associated with reviewing incomplete or corrective work of the Contractor.

1.08 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set each of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract including, but not limited to, all RFI's, CCD's and CO's.

5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress. Do not permanently conceal any work until required information has been recorded.
- E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish main floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Include all plumbing systems, fire protection systems, and electrical systems. For gravity flow lines such as sewers and storm drains, locate all cleanouts, and indicate invert elevations at building lines, changes in direction, intersections, and property lines.
 5. Field changes of dimension and detail.
 6. Details not on original Contract Drawings.
- G. Methods of documenting changes:
 1. Make reproducible transparencies of the Contract Drawings, and a reproducible copy of the Project Manual, all Addenda, Change Orders, and other Contract Documents.
 2. Legibly mark documents with permanent ink; color code as appropriate to separate various types of work.
 3. Provide all required data for Inspector verification prior to closing in concealed work.
 4. Make all changes, corrections, deletions, or additions on transparencies by a competent draftsman.
 5. The construction superintendent shall endorse the transparencies certifying the record drawings are an accurate illustration of the completed Work.
- H. Remove Architect title block and all registration seals from all documents.
- I. Submit documents to Architect prior to final Application for Payment.

1.09 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11-inch text pages, three ring (D shape) side binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project. Include subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on 30-pound white paper, in three parts as follows:
 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.

- c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
- 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.
- E. Data specified in Article 1.07 D above shall incorporate the following:
 - 1. Manufacturer's Manuals: Complete installation, operation, maintenance and service manuals, and printed instructions and parts lists for all materials and equipment where such printed matter is regularly available from the manufacturer. This includes, but is not limited to such service manuals as may be sold by the manufacturer covering the operation and maintenance of his items, and complete replacement parts lists sufficiently detailed for parts replacement ordering to manufacturer. Bound publications need not be assembled in binders.
 - 2. Equipment Nameplate Data: A typewritten list of all mechanical and electrical equipment showing all equipment nameplate data exactly. Identify equipment by means of names, symbols, and numbers used in the contract documents.
 - 3. System Operating Instructions: Typewritten instructions covering operation of the entire system as installed (not duplicating manufacturer's instructions for operating individual components). Include schematic flow and control diagrams as appropriate and show or list valves, control elements, and equipment components using identification symbols and numbers. List rooms, area of equipment served, and show proper settings for valves, controls and switches.
 - 4. System Maintenance Instructions: Typewritten instructions covering routine maintenance of system. List each item of equipment requiring inspection, lubrication, or service and briefly describe such maintenance, including types of lubricants and frequency of service. It is not intended that these instructions duplicate manufacturer's detailed instructions. Give name, address and phone number of nearest firm authorized or qualified to service equipment or provide parts.
- F. Submit 1 draft copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
- G. Submit two sets of revised final volumes, within 10 days after final inspection.
- H. Wall-Mounted Data: Frame one set of typewritten system instructions and diagrams as required under Paragraph 3 and 4 above, covered with glass and mounted in locations as directed by the District. This set of instruction is in addition to those required herein before.

1.10 WARRANTIES

- A. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble in three ring (D-shape) side ring binder with durable plastic cover.
- C. Name District as the beneficiary. In addition, for all equipment and machinery, or components thereof, bearing a manufacturer's warranty that extends for a longer time period than the Contractor's warranty, secure and deliver the manufacturer's warranties in the same manner.
- D. Submit prior to final inspection.
- E. Form of Warranty: Written warranties, except manufacturers' standard printed warranties, shall be on the Contractor's, subcontractor's, material suppliers', or manufacturer's own letterhead, addressed to the District. All warranties shall be submitted in duplicate, and in the form shown

on the following page, modified as approved to suit the conditions pertaining to the warranty.

- F. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.11 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed; obtain receipt prior to final payment.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

**SECTION 01 71 23
FIELD ENGINEERING**

PART 1 - GENERAL

SECTION INCLUDES

2.01 SURVEYING REQUIREMENTS FOR THE WORK.

A. RELATED SECTIONS

1. Section 02310: Grading
 - a. Section 02230: Site Clearing
 - 1) Section 02740: Asphalt Pavement
 - (a) Section 02750: Concrete Pavement
 - (1) Section 02520: Storm Drainage System
 - b. SURVEY SERVICE
 - 1) A. Unless otherwise stated by the Architect or noted in the Special Provisions, the CONTRACTOR shall provide all surveying services.
 - c. PAYMENT FOR SURVEYING
 - 1) The payment for surveying shall be included in respective items of work and shall include, but not to be limited to, construction staking, location and/or relocation of conflicting utilities, locating survey monuments, setting of survey monuments and center line ties, preparing and filing centerline tie sheets and Corner Records, locating Bench Marks and notifying the Office of the County Surveyor of same, professional office services and field calculations, and furnishing all labor, materials, tools, equipment and incidentals for doing all work involved. No additional compensation shall be allowed unless a separate bid item is provided.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 SUBMITTALS

- A. CONTRACTOR shall submit the name and address of the State of California licensed surveyor to CMR, ARCHITECT and OWNER including any changes as they may occur.
 1. CONTRACTOR shall submit to OWNER and/or CMR, ARCHITECT copies of cut sheets, coordinate plots, data collector printouts, and other documentation as available to verify completeness and/or accuracy of field surveying work.
 - a. Statement of Compliance: CONTRACTOR shall submit a statement of certification signed and sealed by Surveyor, counter-signed by CONTRACTOR indicating compliance with grade elevations, slopes and tolerances.
- B. LAYOUT OF THE WORK
 1. CONTRACTOR shall employ a State of California licensed surveyor to lay out the entire Work, set grades, lines, levels, control points, vertical and horizontal control, elevations, grids and positions. Before the commencement of Work, surveyor shall, in conjunction with OWNER and CMR provided engineering survey of the Project site, locate all reference points and benchmarks, then lay out all lines, elevations, and measurements for the entire Work including but not limited to, buildings, grading, paving and utilities.
 - a. All work under this contract shall be built in accordance with the lines and grades shown on the plans. Field survey for establishing these, and for the control of construction, shall be the responsibility of the Contractor. All such survey work including construction staking shall be done under the supervision of a California Licensed Land Surveyor or authorized Civil Engineer. Staking shall be done on all items ordinarily requiring grade and alignment, at intervals normally accepted by the agencies and trade involved.
 - b. The CONTRACTOR shall be responsible for any errors in the finished work, and shall notify the Engineer, in writing, within 24 hours, of any discrepancies, or design errors during the construction staking.

- c. Contractor shall immediately remediate any areas found not to meet specification requirements.

C. PERMANENT SURVEY MARKERS

- 1. Prior to the start of construction, the Contractor's licensed Land Surveyor or qualified Civil Engineer shall, in conformance with Section 8771 of the California State Business and Professions Code, locate all monuments (both of record and not of record), bench marks, and centerline ties within the construction zone, i.e., within one hundred feet of the construction activity. Additional ties to monuments shall be set when ties are missing (min. 4 ties per monument). The Contractor's Surveyor or qualified Civil Engineer shall prepare and submit for review to the City Engineer separate tie sheets and Corner Record sheets (monuments not of record shall have only tie sheets prepared). Corner Records shall conform to the County Engineers' Association of California's "Guide to the Preparation of Records of Survey and Corner Records" document as provided by the County Surveyor's Office. Upon review by the City Engineer, the Land Surveyor shall file the Corner Records with the County Surveyor's Office. Certified Corner Records shall be filed with the City Engineer of the City that the work is being completed in.
 - a. After construction and prior to final acceptance by the Owner of the construction project, the Contractor's land surveyor or qualified Civil Engineer shall re-survey all field monuments and centerline ties within the construction zone, prepare tie sheets and Corner Record sheets as indicated above, and file them with the City Engineer for review. After review by the City Engineer, the Land Surveyor shall file the Corner Records with the County Land Surveyors Office, and file certified copies of the Corner Records with the City Engineer.
 - b. All survey monuments removed or altered as a result of construction shall be reset, Corner Records filed with the County Surveyor's Office, and approved final Corner Records filed with the City Engineer. Centerline ties removed as a result of construction shall be reset and tie sheets filed with the City Engineer.
 - 1) D. The Land Surveyor shall provide a letter of certification for all monuments having four or more existing ties which are within 0.02 ft plus or minus of the original City tie sheet records. When several monuments and ties appear on one tie sheet and one of the ties has changed the Land Surveyor shall re-measure all of the ties and re-file a new tie sheet with the City as required herein.
 - (a) County of Ventura permanent and temporary bench marks within the construction zone shall be located by the surveyor, and the Contractor's Land Surveyor shall send a written notification of impending construction to the County of Ventura Surveyor's Office two weeks prior to construction.

D. SURVEY REQUIREMENTS

- 1. Establish a minimum of two permanent horizontal and vertical control points on the Project site, remote from the building area, referenced to data established by the survey control points.
 - a. Indicate the reference points on the project record drawings with the basis of elevation being the established benchmarks.
 - b. Establish lines, grades, locations and dimensions by instrumentation. From time to time, verify the layout of all Work by the same methods.
 - c. Provide grade stakes and elevations to construct over excavation and re compaction, rough and final grades, paved areas, curbs, gutters, sidewalks, building pads, landscaped areas, and other areas as required.
 - d. Calculate and layout proposed finished elevations and intermediate control as required to provide smooth transitions between the spot elevations indicated in the Contract Documents.
 - e. Provide stakes and elevations for grading, fill, and topsoil placement.
 - f. Provide adequate horizontal and vertical control to locate utility lines, including but not limited to, storm, sewers, water mains, gas, electric and signal and provide vertical control in proportion to the slope of the line as required for accurate

construction. Dry utilities will be based upon adequate horizontal and vertical control layout. Prior to trench closure, survey and record invert and flow line elevations. Survey and record top of curb and flow line elevations on finished concrete or AC surfaces at key locations such as BC's, EC's, grade breaks, corners or angle points in sufficient number to demonstrate the Work complies with the intent of the Contract Documents.

- g. Provide horizontal and vertical control for batter boards for drainage, utility, and other on-site structures as required.
 - 1) Furnish building corner offsets as required to adequately locate building pads. Provide cut and fill stakes within the building pad perimeter adequate to control both over excavation and re-compaction and the final sub-grade elevation of the building pad.
 - (a) Submit a certification, signed by the surveyor, confirming the elevations and locations of improvements are in conformance with the Contract Documents. The statement shall include survey notes for the finish floor and building pad, showing the actual measured elevations on the completed sub-grade, recorded to the nearest 0.01'. Building pad tolerance will be $\pm 0.10'$.
 - (1) ESTABLISHMENT OF GRADES IN HARDSCAPE AREAS
 - 2) A. All work shall conform to the lines, elevations, and grades shown on the Grading Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.
 - (a) Areas having drainage gradients of 2 percent or more shall have elevation stakes, set with instrument, at grid intervals of 25 feet. Intermediate stakes may be set by using a tightly-drawn string line over the tops of adjacent stakes. Grade stakes must be set at all grade breaks, grade changes, etc.
 - (b) Areas having drainage gradients of less than 2 percent shall have elevation stakes, set with instrument, at 10 foot intervals. Grade stakes must be set at all grade breaks, grade changes, etc.
 - (c) Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.

E. STORM DRAIN & SANITARY SEWER PIPE INSTALLATION

- 1. A. All storm drain pipelines, sanitary sewer pipelines, trench drains, catch basins, cleanouts and drain inlets shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.
- 2. RECORD DRAWINGS
- 3. Upon Substantial Completion, CONTRACTOR shall obtain and pay for reproducible transparencies of the as built survey drawings. Deliver to ARCHITECT, final "record" drawings of the original drawings and completed
- 4. within specified tolerances.
 - a. Record drawings shall indicate locations by coordinate of all utilities onsite with top of pipe elevations at major grade and alignment changes, rim grate or top-of curb and flow line elevations of all drainage structures and manholes.
 - b. Completed record drawing transparencies shall be signed and certified as correct and within specified tolerances by the licensed surveyor.
 - c. Attention is called to other sections of the Contract Documents requiring verification or measurements of installed Work by survey. Surveyor shall perform and certify all such surveys or verification are completed in accordance with the Contract Documents.

**SECTION 02 41 00
SELECTIVE DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration and installation purposes.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

- A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
- B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
- D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 DEMOLITION

- A. Remove portions of work as indicated on the drawings and as required to accomplish new work.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of work to be removed.
 - 3. Provide, erect, and maintain temporary barriers and security devices.
 - 4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 6. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.
- D. Minimize production of dust due to demolition operations.
- E. Hazardous Materials:
 - 1. If hazardous materials are discovered during removal operations, stop work and notify Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

3.03 EXISTING UTILITIES

- A. Protect existing utilities to remain from damage.
- B. Do not disrupt public utilities without permit from authority having jurisdiction.
- C. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- D. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 - 1. Verify construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Remove existing work as indicated and required to accomplish new work.
- E. Services including, but not limited to, HVAC: Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 2. Repair adjacent construction and finishes damaged during removal work.
 - 3. Patch to match new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave areas of demolition in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.02 RELATED REQUIREMENTS

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

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.
- B. Measurement and payment of forming work will be by the unit price method.
- C. Formwork (Vertical Structures): Measure by the square foot. Includes form materials, placement, placing accessories, stripping.
- D. Formwork (Horizontal Structures): Measure by the square foot. Includes form materials, placement, placing accessories, stripping.

1.04 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 301 - Specifications for Concrete Construction; 2020.
- C. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- D. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- E. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- I. 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).
- J. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- L. PS 1 - Structural Plywood; 2023.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

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- B. Product Data: Provide data on void form materials and installation requirements.
- C. Designer's Qualification Statement.
- D. Design Data: As required by authorities having jurisdiction.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.
- B. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
- C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.02 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.
- B. Softwood Plywood: PS 1, C Grade, Group 2.
- C. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.
- D. Plywood: Douglas Fir species; solid one side grade; sound undamaged sheets with clean, true edges.
- E. Lumber: Douglas Fir species; Appropriate for intended use grade; with grade stamp clearly visible.

2.03 FORMWORK ACCESSORIES

- A. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - 1. Products:
 - a. Nox-Crete Inc; BIO-NOX: www.nox-crete.com/#sle.
 - b. SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/#sle.
 - c. W. R. Meadows, Inc; Duogard II (water-based): www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.
 - 1. Products:
 - a. BoMetals, Inc: www.bometals.com.
 - b. Or Approved Equal.

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- C. Filler Strips for Chamfered Corners: Rigid plastic type; 3/4" by 3/4"; maximum possible lengths; Nox-Crete Inc; Clean Line Reveal: www.nox-crete.com.

PART 3 EXECUTION

301 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

302 EARTH FORMS

- A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

303 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- G. Coordinate this section with other sections of work that require attachment of components to formwork.
- H. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

304 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

305 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install water stops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

306 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.

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- B. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
- C. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.09 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

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**SECTION 03 20 00
CONCRETE REINFORCING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 03 47 13 - Tilt-up Concrete: Reinforcement for panels.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Grounding connection to concrete reinforcement.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Concrete Construction; 2020.
- B. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- C. ACI SP-66 - ACI Detailing Manual; 2004.
- D. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2019.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- F. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- G. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement; 2019, with Editorial Revision.
- H. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.
- I. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.
- J. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.
- K. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).
- L. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.
- M. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- N. ASTM A1094/A1094M - Standard Specification for Continuous Hot-Dip Galvanized Steel Bars for Concrete Reinforcement; 2020.
- O. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.
- P. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
- Q. CRSI (DA4) - Manual of Standard Practice; 2018, with Errata (2019).
- R. CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

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- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
 - 1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

105 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
 - 1. Maintain one copy of each document on project site.
- B. Provide Architect with access to fabrication plants to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

PART 2 PRODUCTS

201 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, Grade 60 (60,000 psi)
ASTM A615, Grade 40 (40,000 psi)
 - 1. Plain billet-steel bars.
 - 2. Unfinished.
 - 3. Galvanized in accordance with ASTM A767/A767M, Class I.
 - 4. Continuously galvanized in accordance with ASTM A1094/A1094M.
 - 5. Epoxy coated in accordance with ASTM A775/A775M.
- B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
 - 1. Unfinished.
 - 2. Galvanized in accordance with ASTM A767/A767M, Class I.
 - 3. Continuously galvanized in accordance with ASTM A1094/A1094M.
 - 4. Epoxy coated in accordance with ASTM A775/A775M.
- C. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.
 - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
 - 2. Continuously galvanized in accordance with ASTM A1094/A1094M.
 - 3. Epoxy coated in accordance with ASTM A775/A775M.
- D. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
 - 1. Form: Flat Sheets.
 - 2. WWR Style: 4 x 8-W6 x W10.
- E. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

202 RE-BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.
 - 1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.

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1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.
 1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.
 1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

203 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding reinforcement is not permitted.
- C. Welding of reinforcement is permitted only with the specific approval of Architect. Perform welding in accordance with AWS D1.4/D1.4M.
 1. Galvanized Reinforcement: Clean surfaces, weld and re-protect welded joints in accordance with CRSI (DA4).
- D. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
- E. Locate reinforcing splices not indicated on drawings at point of minimum stress.
 1. Review locations of splices with Architect.

PART 3 EXECUTION

301 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as per structural drawings.
- E. Comply with applicable code for concrete cover over reinforcement.
- F. Bond and ground all reinforcement to requirements of Section 26 05 26.

302 FIELD QUALITY CONTROL

- A. An independent testing agency will inspect installed reinforcement for conformance to contract documents before concrete placement.

303 SCHEDULES

- A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.
- B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and welded wire reinforcement, galvanized finish.

END OF SECTION

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**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 SUMMARY

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

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture, by a recognized, approved testing laboratory.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete"
 - 2. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials"
 - 3. ACI 318 - 19, "Building Code Requirements for Structural Concrete"

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60 and Grade 40 or ASTM A 706 where welded rebar occurs, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- 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."

2.03 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type V, gray
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 - 1. Maximum Coarse-Aggregate Size: 1 inch
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.04 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

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- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will 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.

205 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

206 VAPOR BARRIERS

- A. Sheet Vapor Barrier: As required by Section 03 05 16 - Underslab Vapor Barrier.

207 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. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding offloor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

208 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

209 CONCRETE MIXTURES

- 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 and ACI 318, Ch. 5. Submit to Architect/Engineers & Special Inspector for review of general conformance.
- B. Cementitious Materials: Fly ash requirements with CBC 1903A.5. Fly ash or other pozzolan can be used as a partial substitute for ASTM C 150 portland cement as follows:
1. Fly ash or other pozzolan shall conform to ASTM C 618 for Class N or Class F materials (Class C is not permitted)
 2. No more than 15 percent by weight of fly ash or other pozzolans shall be permitted to be substituted for ASTM C 150 portland cement if the mix design is proportioned per ACI 318-14 Section 26.4.1.1. See 2022 CBC section 1904A for durability requirements.

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3. No more than 15 percent by weight of ground-granulated blast-furnace slag conforming to ASTM C 989 shall be permitted to be substituted for ASTM C 150 portland cement if the mix design is proportioned per ACI 318-14 Section 26.4.1.1. See 2022 CBC section 1904A for durability requirements.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing high-range water-reducing or plasticizing 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.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Normal Weight Concrete:
 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,500 pounds per square inch.
 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
 4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
 5. Cement Content: Minimum 5 sacks per cubic yard.
 - a. Minimum 5 sacks per cubic yard.
 - b. Maximum 7 sacks per cubic yard.
 6. Water-Cement Ratio: Maximum 45 percent by weight.
 7. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
 8. Maximum Slump: See structural plans.
 9. Maximum Aggregate Size: 1 inch.

210 FABRICATING REINFORCEMENT

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

211 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

301 FORMWORK

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

302 EMBEDDED ITEMS

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

303 VAPOR BARRIERS

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

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304 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

305 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. Architect to review if submittal and review by AOR is required.
- 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 one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- 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. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

306 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 305R.

307 FINISHING FORMED SURFACES

- A. Rough-Formed Finish at surfaces not exposed to view: 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.
- B. Smooth-Formed Finish at surfaces exposed to view: 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.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete:
 - 1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

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- 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.

308 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. 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 restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Float Finish: Apply to surfaces indicated to receive trowel finish and are to be covered with fluid-applied or sheet waterproofing.
- C. Trowel Finish Slab on Grade: 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. Trowel Finish: Apply to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. 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.
- D. Trowel and Fine-Broom Finish Flatwork: Apply a first trowel finish to surfaces, while concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete steps, ramps, and elsewhere as indicated.
- F. Sand Blast Finish: Light and medium where indicated.

309 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 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

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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.

3.10 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.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

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**SECTION 05 12 00
STRUCTURAL STEEL**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.

1.02 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that is approved by the City of Los Angeles as an approved fabricator of structural steel.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel" & AWS D1.8.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. AISC 341.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992
- B. Channels, Angles: ASTM A 36
- C. Plate and Bar: ASTM A 36
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.02 THREADED FASTENERS

- A. Machine Bolts: Unless noted otherwise, ASTM A307, Grade A. Provide ASTM A563, Hex, Grade A Nuts and ASTM F 436 Washers

2.03 PRIMER

- A. Approved VOC complaint primer, suitable for subsequent finishes as specified and shown in other portions of the Contract Documents.

2.04 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to

AISC 360.

206 SHOP CONNECTIONS

- A. Retain option in "Weld Connections" Paragraph below for "High-Seismic Applications" as defined in AISC 360.

207 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

208 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M

209 HOT-DIPPED GALVANIZED

- A. Structural steel shall be Hot-dipped galvanized after Fabrication, where steel and connectors are exposed to weather or as noted on Structural Drawings.
 - 1. Steel framing members and ferrous metal items, specifically shown or noted on drawings as galvanized, shall be galvanized by the hot-dip process, conforming to ASTM A 123, Grade 75.
 - 2. Steel connection components, including bolts, washers and nuts, shall be galvanized by the hot-dip process conforming to ASTM A 153.

PART 3 - EXECUTION

301 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment's for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

302 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates: Clean -bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before

- packing with grout.
- 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

303 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

304 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M & AWS D1.8.

END OF SECTION 05 12 00

SECTION 06 10 53
Miscellaneous Rough Carpentry

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking, nailers, curbs, and furring.
2. Plywood and sheathing not part of structural framing.
3. Temporary supports and bracing.
4. Rough framing in support of other work (e.g., casework, equipment, roof openings).

B. Related Sections:

1. 06 10 00 – Rough Carpentry
2. 09 90 00 – Painting and Coating

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data for each type of product.
B. Fastener data and anchorage systems, if non-standard.
C. Certificates: For preservative treatment, fire retardant treatment (as applicable).

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and plywood from moisture, dirt, and damage.
B. Stack materials flat, off the ground, and under cover.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Framing Lumber:

1. Dimension lumber: No. 2 grade or better, SPF or Douglas Fir, kiln-dried.
2. Blocking and nailers: Same as above or utility grade where concealed.

B. Plywood:

1. APA-rated sheathing, Exposure 1, thickness as indicated or minimum 1/2".
2. Fire-retardant-treated plywood where required by code.

C. Preservative Treatment:

1. Pressure-treated to meet AWWA U1 and M4 for wood in contact with concrete or exposed to moisture.
2. Identification
Wood to be preservative treated shall bear the quality mark of an inspection agency that maintains continuing supervision, testing and inspection over the quality of the preservative-treated wood. Inspection agencies for preservative-treated wood shall be listed by an accreditation body that complies with the requirements of the American Lumber Standards Treated Wood Program, or equivalent. The quality mark shall be on a stamp or label affixed to the preservative-treated wood, and shall include the following information:
 - Identification of treating manufacturers.
 - Type of preservative used.
 - Minimum preservative retention (pcf).
 - End use for which the product is treated.
 - AWWA standard to which the product was treated.
 - Identity of the accredited inspection agency.
3. Moisture Content
Where preservative-treated wood is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other materials.

D. Fasteners:

1. Nails, screws, bolts: Galvanized for exterior or treated wood.
2. Powder-actuated fasteners if approved.
3. Anchors: Expansion or adhesive type as approved.

PART 3 – EXECUTION**3.1 INSTALLATION**

- A. Install materials level, plumb, and true to line.
- B. Provide blocking and supports as required for anchorage of finish materials, fixtures, and equipment.
- C. Coordinate with other trades to ensure proper placement of blocking and rough carpentry.
- D. Secure rough carpentry using specified fasteners.
- E. Cut and fit accurately around other work.

3.2 PROTECTION

- A. Protect installed rough carpentry from damage during subsequent construction.
- B. Replace damaged or deteriorated wood prior to finish work.

END OF SECTION

**SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud ceiling framing.
- B. Acoustic insulation.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 53 - Miscellaneous Rough Carpentry

1.03 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2018a.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- H. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- I. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

1.04 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01 33 00 Submittal Procedures. Indicate special details associated with fireproofing and acoustic seals.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754 provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- E. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, illustrating finish color and texture.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 5 years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 ASTM C840 and GA-216

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories (See also Section 09 2216):
 - 1. ClarkDietrich; www.clarkdietrich.com
 - 2. Marino; www.marinoware.com
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling: Studs as shown on the drawings
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
- C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company; www.americangypsum.com.
 - 2. CertainTeed Corporation; www.certainteed.com
 - 3. Georgia-Pacific Gypsum; www.gpgypsum.com
 - 4. National Gypsum Company; www.nationalgypsum.com
 - 5. USG Corporation; www.usg.com
 - 6. See Section 01 63 00 - Product Substitution Procedures.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 3. Thickness:
 - a. Ceilings: 1/2 inch (13 mm).
 - 4. Paper-Faced Products:
 - a. American Gypsum; EagleRoc Regular Gypsum Wallboard and FireBloc Type X Gypsum Wallboard.
 - b. CertainTeed Corporation; ProRoc Brand Gypsum Board.
 - c. CertainTeed Corporation; ProRoc Brand Abuse Resistant Gypsum Board.
 - d. Georgia-Pacific Gypsum; ToughRock.
 - e. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
 - 5. Mold Resistant Paper Faced Products:
 - a. American Gypsum Company; M-Bloc.
 - b. American Gypsum; M-Bloc AR Type X.
 - c. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - d. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - e. National Gypsum Company; Gold Bond Hi-Abuse Brand XP Wallboard.
- C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch (13 mm).
 - 3. Edges: Tapered.
 - 4. Products:
 - a. American Gypsum; Interior Ceiling Board.
 - b. CertainTeed Corporation; ProRoc Interior Ceiling.
 - c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.

- d. National Gypsum Company; High Strength Brand Ceiling Board.
- e. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.

2.04 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665 ; preformed glass fiber, friction fit type, unfaced. Thickness: Width of stud unless otherwise noted.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Finishing Accessories: ASTM C1047 , galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Joint Compound: Setting type, field-mixed.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002 ; self-piercing tapping screws, corrosion resistant.
- F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
 - 1. Spacing: As indicated.
- F. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.
- G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
- H. Blocking: Install mechanically fastened steel sheet blocking for support of:
 - 1. Wall mounted cabinets.
 - 2. Plumbing fixtures.
 - 3. Toilet partitions.
 - 4. Toilet accessories.

5. All other wall mounted equipment needing blocking and support

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Place continuous bead at perimeter of each layer of gypsum board.
 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
- F. Cementitious Backing Board: Install over steel framing members and substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Corner Beads: Install at external corners, using longest practical lengths.
- B. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840 as follows:
 1. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
- C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 FINISHING

- A. General: Tape, fill, and sand exposed joints, edges, corners, and openings, to produce surface ready to receive surface finishes. Comply with applicable recommendations of ASTM C 840, GA-214 and GA 216 recommendations.
- B. Levels required for locations as follows:
 1. Level 3:

- a. Provide at locations such as plenum areas above ceilings, in attics and other concealed areas, in service spaces not exposed to view, under paneling, and where used as substrate for tile.
- 2. Level 4:
 - a. Use typically unless otherwise noted.
- 3. Level 5:
 - a. Provide at locations noted on drawings.
 - 1) Primer-Surfacer Spray- On Pretreatment: Vinyl-acrylic-latex-based coating substitute for skim coat and primer at Level 5 gypsum board finishes, equal to sheetrock Brand Primer-Surfacer manufactured by USG, Proform Surfacer/Primer manufactured by National Gypsum, or equal.
- C. Finish levels adapted from reference standards GA 214 and GA 216:
 - 1. Level 3: All joints and interior angles shall have tape embedded in joint compound and one additional coat of joint compound applied over all joints and interior angles. Fastener heads and accessories shall be covered with two separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
 - 2. Level 4: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
 - 3. Level 5: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat(s) of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer's recommendations, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.

3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

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**SECTION 09 90 00
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Interior painting and coating systems.

1.02 RELATED REQUIREMENTS

- A. Section 09 96 00 - High-Performance Coatings: Other painted metal items.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- C. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015).; 2003.

1.04 REGULATORY REQUIREMENTS

- A. Conform to T24, CCR for flame and smoke rating requirements for finishes.
- B. Conform to T19, CCR for all application processes and safety procedures.
- C. Materials shall comply with FDA requirements.
- D. Conform to requirements of SCAQMD.
- E. 2022 California Green Building Standards Code

1.05 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.06 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
- D. Maintenance Data: Submit coating maintenance manual including care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color and gloss, store where directed.
 - 3. Label each container with color, type, and gloss in addition to manufacturer's label.

1.07 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide Dunn Edwards products indicated; Contact Kim Hampton – Kim.Hampton@DunnEdwards.com
- B. Acceptable Manufacturers subject to submitting products that meet or exceed performance and physical characteristics of basis of design products:
 - 1. Sherwin Williams.
 - 2. PPG.
 - 3. Vista.

2.02 PAINTINGS AND COATINGS

- A. General:
 - 1. Provide materials for use within each paint system that are compatible with one another, and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide factory-mixed coatings unless otherwise indicated.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction
- C. Colorants: The use of colorants containing hazardous chemicals, such as ethylene glycol, is prohibited and zero VOC colorants should be used whenever possible.
- D. Colors: As selected by the Architect.
- E. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SCHEDULE - INTERIOR

- A. Gypsum Board Substrates: 3 coats
 - 1. Prime Coat: Primer sealer, latex, Vinylastic Premium VNPR00.
 - 2. Intermediate Coat: Latex, interior, matching topcoat.
 - 3. Topcoat: Paint gloss and colors as scheduled on drawings.
 - a. Latex, interior, eggshell, Spartawall Eggshell SWLL30
 - b. Latex, interior, semi-gloss, Spartawall Eggshell SWLL50
 - c. Latex, interior, flat, Spartazero Flat SZRO10
- B. Gypsum Board Substrates (where indicated for enamel paint): 3 coats
 - 1. Prime Coat: Vinylastic Slect Latex wall sealer (VNSL00)
 - 2. Intermediate Coat: Enduracat Semi-Gloss Pre-CAtalyzed, water based, single component epoxy (ENPX50)
 - 3. Topcoat: Enduracat Semi-Gloss Pre-Catalyzed, water based, single component epoxy (ENPX50)

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

- A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing. Mask permanent labels for items certified or tested by Underwriter's Laboratories, Warnock-Hersey, or other testing agencies, fusible links, and identification stamps.
- B. Clean surfaces thoroughly and correct defects prior to application.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- D. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.
- E. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness and a uniform finish.
- D. Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- E. Walls with Base: Paint the entire wall, including the wall behind the base.

3.04 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items factory primed or factory finished items if acceptable to top coat manufacturers.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 23 00 10
BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

1.2 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.3 WORK INCLUDED

- A. The complete Heating, Ventilating and Air Conditioning (HVAC) systems, including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions and locations of existing utilities, fans, and thermostats at the jobsite.
 - 3. Duct systems; supply, return and exhaust complete with fire dampers, combination fire-smoke dampers, and manual dampers.
 - 4. Diffusers and registers.
 - 5. Exhaust supply, return fans and air curtains.
 - 6. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 7. Duct lining and insulation.
 - 8. Shop drawings.
 - 9. Equipment identification.
 - 10. Equipment and systems adjustments and balancing.
 - 11. Air, water and gas systems testing, adjusting and balancing.
 - 12. Written operating and maintenance instructions.
 - 13. Record drawings.
 - 14. Guarantee

1.4 WORK SPECIFIED ELSEWHERE

- A. Concrete, Rough Carpentry, Joint Sealants, Sheet Metal, Flashing and Trim, Access Door and Frames, Acoustical Ceiling Tile, Door Hardware, Paints and Coatings, Plumbing and Electrical.

1.5 SITE INSPECTION

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall

observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

1.6 ORDINANCES, REGULATIONS AND CODES

- A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.
1. AFI - Air Filter Institute
 2. AMCA - Air Moving & Conditioning Association
 3. ARI - Air Conditioning & Refrigeration Institute
 4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 5. ASME - American Society of Mechanical Engineers
 6. ASTM - American Society of Testing Materials
 7. AWS - American Welding Society Code
 8. ANSI - American National Standards Institute
 9. CBC - California Building Code
 10. CCR - California Code of Regulations
 11. CEC - California Electrical Code
 12. CFC - California Fire Codes
 13. CMC - California Mechanical Code
 14. CPC - California Plumbing Code
 15. FIA - Factory Insurance Association
 16. NAFM - National Association of Fan Manufacturers
 17. NEMA - National Electrical Manufacturer's Association
 18. NFPA - National Fire Protection Association
 19. ORS - Office of Regulatory Services
 20. SCAQMD - South Coast Air Quality Management District
 21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
 22. UFC - Uniform Fire Code
 23. UL - Underwriter's Laboratories
 24. UPC - Uniform Plumbing Code
- B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.
- C. Codes and Standards:
1. IBC and California Amendments (California Building Code - Part 2, Title 24, CCR).
 2. UMC and California Amendments (California Mechanical Code - Part 4, Title 24 CCR).
 3. UPC and California Amendments (California Plumbing Code - Part 5, Title 24 CCR).

- 4. Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24 CCR).
- 5. National Fire Protection Associations - National Fire Code.
- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.
- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.7 PERMITS, FEES AND INSPECTIONS

- A. Obtain and pay for all necessary permits, fees, assessments, complimentary drawings, required by any legally constituted public authorities having jurisdiction.

1.8 DRAWINGS AND SPECIFICATIONS

- A. The Architect's decision will be final on interpretation of the Drawings and Specifications.
- B. The Drawings and Specifications are complimentary. Any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both.
- C. Piping, ductwork and other equipment shown as existing has been taken from the Owner's drawings. Contractor shall verify exact location in field before proceeding with the work.
- D. Where codes, standards, drawings or specifications conflict, the most stringent shall prevail, unless prior approval for variance is obtained. Specific details on the drawings shall supersede the specification in the event of a conflict.
- E. Alternate support or seismic detail proposed by contractor shall have prior approval by the Architect; and the Contractor shall obtain agency approval without any additional cost or time to the contract and without any time penalty on the work schedule.

1.9 SUBMITTALS

- A. Before starting work, the Contractor shall furnish for the approval of the Architect, Shop Drawings and Submittals with Itemized Equipment Lists, complete in all details that they proposes to install. All items shall be submitted at the same time.
- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.
- C. Variations or deviations on submitted items from that specified must be clearly tagged and / or identified
- D. Submittals shall include, but not necessarily be limited to the following which are mandatory:
 - 1. Draw Equipment Layouts to 1/4" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
 - 2. Schedule of pipe, fittings, valves, with manufacturer and catalog number.

3. Specialties, valves, gauges and thermometers of all types.
4. Foundations, supports, hangers, inserts.
5. Earthquake supports and calculations.
6. Insulation.
7. Ventilation and air conditioning equipment, specialties and the air control systems.
8. Fans, fan characteristic curves, fan tests.
9. Dampers, louvers, grilles, registers, diffusers.
10. Shop fabrication drawings and installation drawings of ductwork and piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping and ductwork to finish floor level.
11. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
12. Automatic control system diagrams.
13. Exhaust, supply and return fans.
14. Access panels.
15. Hangers, inserts, supports, anchors.
16. Pipe, fittings and specialties.
17. Pipe isolators.
18. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
19. Expansion joints, guides and anchors.
20. Shop fabrications drawings and calculations.
21. Special and miscellaneous products furnished under this section and not listed herein.

1.10 RECORD DRAWINGS AND MANUALS

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 01 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.

- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 2. Specifications
 3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 4. Grouting requirements.
 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.
 6. Start-up and beginning operation procedures.
 7. Operational procedures.
 8. Shutdown procedures.
 9. Maintenance and calibration procedures
 10. Parts lists
 11. Name, address and telephone number of each manufacturer's local representative.
- H. Manual Submittals: Unless otherwise specified, each submittal shall include two copies of each manual, one of which will be returned to the Contractor, marked to show the required review. When approved, deliver four copies to Architect unless otherwise specified.
- I. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided prior to commencement of air and water balance.

1.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, equipment and materials used in the installation shall be new and in perfect condition when installed. Articles provided for the same general purpose or use shall be of the same make. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work, together with all necessary journeymen, helpers and laborers required.

1.12 SEISMIC DESIGN

Clarify. Cannot rely on contractor.

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure. The anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. Conform to the following:
1. In accordance with Title 24, 2022 CBC Chapter 16A, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
 2. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2022 CBC Chapter 16A. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

2.1 SUBSTITUTIONS AND CHANGES

- A. The design has been based on data from certain manufacturers, suitable for each application. Recommendations for alternative manufacturers are made for each product, except when "no substitutions permitted" is indicated.
- B. It is the intent of the Owner to have this project constructed with materials, products and system originally designed and specified into the project.
- C. Alternatives that may require the modification, realignment and/or adjustment of other associated components, including impact on other trades, shall be accomplished at no additional cost or time to the contract and shall have the approval of the Architect.
- D. Substitutions shall be submitted addressing all features listed in the specifications. Features that deviate from the plans and specifications shall be clearly identified including justification for deviations. Design West Engineers will review initial submittal on substitutes only. Subsequent submittals made to correct deficiencies in original submittals will be reviewed at Contractor's expense based on Design West Engineer's hourly rate for engineering services.
- E. Should the Contractor elect to propose substitutions for the Owner's interest, the substitutions shall be in compliance with Division 01.

2.2 SUBMITTAL REVIEWS

- A. The Architect and / or Engineer will have the right to accept or reject equipment, materials, workmanship, tests and determine when the Contractor has complied with the requirements herein specified.

2.3 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS

- A. Immediately after award of the Contract and after the final review of submittals by the Architect and / or Engineer, the Contractor shall arrange for the purchase and delivery of equipment and materials required, in ample quantities and at the proper time to meet the construction schedule. The contractor shall deliver to the Architect and Owner a complete list of equipment and materials ordered, giving descriptions, plate numbers, brochures, name of the wholesalers, date of the orders and approximate delivery dates.

2.4 LOCATIONS AND ACCESSIBILITY

- A. Drawings show pipe and ductwork diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences as reviewed by Architect and / or Engineer. Install piping and ductwork to best suit field conditions after coordinating with other trades. Run exposed piping and ductwork parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.
- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, cleanouts, dampers, controls, steam and water specialties, duct access doors or any other indicating equipment or specialties requiring reading,

adjustment, inspection, maintenance shall be conveniently and accessible located with reference to the finished building.

- D. Where wall and ceiling access doors are required but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.
- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

2.5 COORDINATION OF TRADES

- A. Contractor shall coordinate all trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit, and ducts and to maintain maximum headroom and accessibility.
- B. No extras will be allowed for changes made necessary by interference or coordination between trades.
- C. Submit Composite Coordination Drawings in accordance with Submittal Procedures. Include dimensioned plans, elevations, sections and details and give complete information particularly as to the kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, lighting, structural interferences. Coordinate these Composite Coordination Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervision of field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified in Division 01. Do not start installation of work involved under Composite Coordination Drawings until the Architect reviews applicable submittal. Discrepancies between the Drawings and Composite Coordination Drawings shall be specifically noted and identified on the Composite Coordination Drawings. Drawings for the various trades involved shall be submitted as required and reviewed prior to preparation of Composite Coordination Drawings.
 - 1. Equipment Foundations and Bases: Furnish certified details and drawings for approval before fabrication. Furnish parts necessary for each foundation subbase and support.
 - 2. Pipe Sleeves and Inserts: Furnish and install pipe sleeves and pipe support inserts before concrete is poured.
 - 3. Roof, Wall and Floor Openings: Furnish Shop Drawings showing exact locations and sizes of openings through roofs, walls and floors.
 - 4. Concrete: Conform to Concrete Section of the Specifications.

2.6 GUARANTEES

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item and any

other damage caused to the building free of charge to the Owner, including cost of labor and materials.

B. Guarantee included in this section to cover:

1. Faulty or inadequate design of equipment or material installed
2. Improper assembly or erection
3. Defective workmanship or material
4. Incorrect or inadequate operation or other failure

C. The contractor shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise

D. Furnish the parts and labor to replace any items found to be defective in the mechanical equipment with the guarantee period.

E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.

F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty and proof of shipment date or purchase date per terms of warranty to the Owner, who shall be named as beneficiary.

2.7 PROTECTION OF EQUIPMENT AND MATERIALS

A. Provide adequate storage facilities for equipment and materials on the site and shall make provisions to protect such materials and equipment from damage.

2.8 CLOSING-IN OF UNINSPECTED WORK

A. Contractor shall not allow or cause any of the work, specifically ductwork and piping, to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Should any of work be covered up or enclosed before such inspection and test, he shall at his own expense, uncover the work and after it has been inspected, tested, and approved, make repairs with such materials as may be necessary to restore work to its original and proper condition.

2.9 BUILDING FOOTING CLEARANCES

A. Under no circumstances shall pipes, ducts, or conduits penetrate footings. They shall cross below footings or through sleeves above footings. Those running parallel to footings shall have the minimum clearance from the cone of influence indicated on the Drawings or as required by Code.

2.10 DAMAGE BY LEAKS

A. Contractor shall be responsible for all damage to any part of the premises caused by rain leaks through or around ducts or pipes, leaks or breaks in piping, equipment or fixtures furnished or installed by him for a period of one (1) year from the date of Substantial Completion.

2.11 EQUIPMENT LABELS

A. Equipment provided under this Section shall be provided with the manufacturer's metal identification labels attached to each individual piece of equipment showing complete performance characteristics, size, model and serial number.

2.12 PRELIMINARY OPERATION

- A. Should the Owner request that any portion of the plant, apparatus, or equipment be operated for the Owner's beneficial use prior to the final completion and acceptance of the work, the Contractor shall conform to Beneficial Occupancy Provisions of the General Conditions. Such operation shall be under the supervision and direction of the Contractor. Such preliminary operation shall not be construed as an acceptance of any of the work.

2.13 ELECTRICAL WORK

- A. Coordinate with Division 26 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.
- B. Voltage for electrical work will be included in Division 26. However, any control wiring which is required that is not shown on the control diagram shall be as described under this Section. In the event that the Contractor chooses to provide equipment that requires extra expense in the power or control wiring, he shall pay additional electrical costs.
- C. Safety switches, starters, circuit breakers, unless provided as a portion of package equipment, and the electrical connections of mechanical equipment to the electrical power service shall be provided under Division 26.
- D. Interconnecting wiring, safety switches, relays, controllers and motor starters which are integral components of packaged equipment shall be provided as an integral part of that equipment.
- E. All interconnecting power wiring and conduits shall be provided by Division 26.
- F. Control wiring shall be provided by Division 23, unless otherwise indicated on the drawings.
- G. Conduit for control wiring shall be provided by Division 26.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following hangers and supports for mechanical system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.
 - 4. Division 23 Section "Pipe Expansion Fittings and Loops" for flexible pipe.
 - 5. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems. Not allowed for this project.
 4. Pipe positioning systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
- C. Welding and brazing certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: ANSI/MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: ANSI/MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

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

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Before Installation: Verify suitability for use in lightweight concrete or concrete slabs less than 4 inches thick with project structural engineer.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
 - 1. Submit: Calculations and details of each pipe stand unit.
 - 2. Available Manufacturer: MIRO Industries.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Base: Stainless steel.
 - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 1. Available Manufacturer: Portable Pipe Hangers.
 2. Bases: One or more plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Available Manufacturer: HOLDRITE Corp.; Hubbard Enterprises.

2.9 EQUIPMENT SUPPORTS

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

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Non-staining, non-corrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with ANSI/MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- E. Use padded hangers for bare piping for noise abatement.
- F. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members notching. Provide such members with reinforcement steel straps of Kees Protecta-Plate or equal.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 and larger, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 and larger.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, if longer ends are required for riser clamps.

- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 2. Side-Beam Brackets (MSS Type 34): For sides of wooden beams.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Each trapeze pipe hanger requires submittal of calculations and details.

2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
1. Each metal framing system requires submittal of calculations and details.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
1. Each pipe stand in requires submittal of calculations and details.
 2. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 3. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 for curbs specifications.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
1. Each equipment support requires submittal of calculations and details.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- O. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood inserts.
- 6. Insert Material: Length at least as long as protective shield.
- 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedure for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

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

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Pipe markers.

1.2 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Piping: Tags.
- C. Thermostats: Nameplates.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC; _____: www.advancedgraphicengraving.com/#sle.
 - 2. Brimar Industries, Inc; _____: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co; _____: www.kolbipipemarkers.com/sle.

5. Letter Color: White.
6. Letter Height: 1/4 inch.
7. Background Color: Black.
8. Plastic: Comply with ASTM D709.

2.3 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving; _____: www.advancedgraphicengraving.com/#sle.
2. Brady Corporation; _____: www.bradycorp.com/#sle.
3. Brimar Industries, Inc; _____: www.pipemarker.com/#sle.
4. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
5. Kolbi Pipe Marker Co; _____: www.kolbipipemarkers.com/#sle.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 23 for stencil painting.

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. Apply stencil painting in accordance with Section 09 91 23.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Identify piping, concealed or exposed, with stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet 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. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

- H. 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. Measurement of final operating condition of HVAC systems.
- C. Commissioning activities.

1.2 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. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.3 SUBMITTALS

- A. The contractor shall procure the services of an independent Air Balance and Testing Agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The independent agency shall be certified and in good standing with the AABC.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. 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.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with Architect 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. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.

- d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Expected problems and solutions, etc.
 - g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - h. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - l. Method of checking building static and exhaust fan and/or relief damper capacity.
 - m. Time schedule for deferred or seasonal TAB work, if specified.
 - n. False loading of systems to complete TAB work, if specified.
 - o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - p. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - q. Procedures for formal progress reports, including scope and frequency.
 - r. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to the Commissioning Authority.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Progress Reports.
- G. 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 the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

7. 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 Architect.
 - g. Project Engineer.

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).
 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. A minimum of two air balance test shall be completed for the project. One shall be completed prior to any demolition is made to test existing systems in scope of work. Second test shall begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. 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.
- D. TAB Agency Qualifications:
 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 2. Certified by the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 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. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 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. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner and / or project inspector.

3.5 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. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. 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.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.02 inches negative static pressure in chemical storage rooms.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 COMMISSIONING

- A. Perform prerequisites prior to starting commissioning activities.
- B. Include cost for commissioning requirements in the contract price.
- C. Attend commissioning meetings scheduled by the CxA when requested. TAB will need to be present 2 weeks prior to the start of TAB to review the TAB plan/procedures and weekly/bi-weekly during the on-site TAB work.

- D. Submit the TAB plan/procedures to the CxA for review at least two weeks prior to beginning TAB work.
- E. Notify the CxA a minimum of two weeks in advance of scheduled TAB work.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.
 - 1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 - 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as a Mechanical Acceptance Test Technician employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Participate in the Functional Performance Tests as required to achieve design intent.
- I. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- J. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for ____ percent of the air handlers plus a random sample equivalent to ____ percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- K. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.

2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.7 SCOPE

- A. Test, adjust, and balance the following:
 1. Packaged Roof Top Heating/Cooling Units.
 2. Air Handling Units.
 3. Fans.
 4. Air Filters.
 5. Air Inlets and Outlets.

3.8 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. V-Belt Drives:
 1. Identification/location.
 2. Required driven RPM.
 3. Driven sheave, diameter and RPM.
 4. Belt, size and quantity.
 5. Motor sheave diameter and RPM.
 6. Center to center distance, maximum, minimum, and actual.
- C. Air Cooled Condensers:
 1. Identification/number.
 2. Location.
 3. Manufacturer.

4. Model number.
5. Serial number.
6. Entering DB air temperature, design and actual.
7. Leaving DB air temperature, design and actual.
8. Number of compressors.

D. Cooling Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Entering water temperature, design and actual.
13. Leaving water temperature, design and actual.

E. Heating Coils:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

F. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.

4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

G. Exhaust Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

H. 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.

I. Flow Measuring Stations:

1. Identification/number.
2. Location.

3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Actual/final pressure drop.
9. Actual/final flow rate.
10. Station calibrated setting.

J. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

K. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.

1.2 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 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.

1.6 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.

1.7 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 or ASTM E84.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com.
- B. 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.

2.3 DUCT LINER

- A. Manufacturers:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
- B. Note: Choose the liner type - Elastomeric Foam, Glass Fiber, or Phenolic Foam.
- C. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer or acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
 - 1. Apparent Thermal Conductivity: Maximum of .24 at 75 degrees F.

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. Install in accordance with NAIMA National Insulation Standards.

- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Finish with tape and vapor barrier jacket.
 - 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
- E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. External Duct Insulation Application:
 - 1. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 2. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
- G. Duct and Plenum Liner Application:
 - 1. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 - 2. Seal and smooth joints. Seal and coat transverse joints.
 - 3. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.3 R-VALUE FOR INSULATION ON DUCTS SHALL BE PER TITLE-24 REQUIREMENTS

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Filter-driers.
- F. Solenoid valves.
- G. Expansion valves.

1.2 REFERENCE STANDARDS

- A. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.
- B. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.
- C. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants; 2014.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- F. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- G. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- H. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the 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. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.

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2. Use gauge taps at compressor inlet and outlet.

E. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

F. Solenoid Valves:

1. Use in liquid line of single or multiple evaporator systems.

1.4 SUBMITTALS

A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.5 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. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

2.2 REGULATORY REQUIREMENTS

2.3 PIPING

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.

B. Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.

C. 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.

2.4 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

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2.5 VALVES

A. 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.

2.6 FILTER-DRIERS

A. Performance:

1. Flow Capacity - Liquid Line: ____ ton, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
3. Design Working Pressure: per manufacturer's recommendation, minimum.

B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.

1. Connections: As specified for applicable pipe type.

2.7 SOLENOID VALVES

A. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.

B. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

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. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. 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.

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- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 31 00.
- H. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- I. Refrigerant piping shall be provided with insulation. All exterior insulation shall be provided with an aluminum jacket and UV protection.

END OF SECTION

23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ducts.

1.2 RELATED REQUIREMENTS

- A. Section 23 01 30.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 37 00 - Air Outlets and Inlets: Fabric air distribution devices.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- F. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2021.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.5 SUBMITTALS

- A. Product Data: Provide data for duct materials, duct liner, and duct connections.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 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 and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 33 19.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
- F. 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. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
 - 7. 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.

2.2 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. 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.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

C. Flexible Ducts:

1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.
 - c. Temperature Range: -20 degrees F to 210 degrees F.

D. Insulated Flexible Ducts:

1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.
 - c. Temperature Range: -20 degrees F to 210 degrees F.

E. Low Pressure Supply (System with Cooling Coils): 1 inch w.g. pressure class, galvanized steel.

F. Medium and High Pressure Supply: 6 inch w.g. pressure class, galvanized steel.

G. Return and Relief: 1 inch w.g. pressure class, galvanized steel.

H. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

I. Hanger Rod: ASTM A 36/A 36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 DUCTWORK FABRICATION

- A. Fabricate ductwork gauge in accordance with current (CMC) California Mechanical Code and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Tee's, bends, and elbows: Construct according to (CMC) California Mechanical Code and SMACNA (DCS).
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- F. 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.

2.4 DUCT MANUFACTURERS

- A. Metal-Fab, Inc: www.mtlfab.com.
- B. SEMCO Incorporated: www.semcoinc.com.

C. United McGill Corporation: www.unitedmcgill.com.

2.5 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

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. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

E. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

F. Locate ducts and dampers with sufficient space around equipment to allow normal operating and maintenance activities.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.

H. Use double nuts and lock washers on threaded rod supports.

I. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

J. Connect diffusers or return air boots to low pressure ducts with 5 feet maximum length of flexible duct.

K. Flexible air ducts shall not be used in lieu of ridged elbows or fittings. Flexible air ducts shall be permitted to be used as an elbow at a terminal device

1. Elbow at a terminal device shall be provide with straps and support, "FlexRight" (Durable Elbow Support).
2. Shall be a universal-mount, 1-piece, fully adjustable, radius forming brace
3. Classified: UL 2043
4. Material: 100 percent recycled copolymer polyporpylene

- 5. Support Frame Radius: 8 Inches
- 6. Compliance for Flexible Duct Radius with SMACNA HVAC Duct Construction Standards and ASHRAE Advanced Energy Design Guides
- 7. Manufacturer: Build Right Products or equal
- L. Install flexible duct elbow supports in accordance with manufacturer's instructions.
- M. Install flexible duct elbow supports over outer jacket of flexible ducts to form smooth, 90-degree bends to eliminate flexible duct kinks and airflow restrictions
- N. Make bends in flexible ducts with minimum of 1-duct diameter centerline radius
- O. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- P. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 CLEANING

- A. Clean thoroughly each duct system. See Section 23 01 30.51.
- B. Clean duct system by forcing air at high velocity through duct to remove accumulated dust. Clean half the system at a time to obtain sufficient air. Protect equipment that could be harmed by excessive dirt with temporary filters or bypass during cleaning.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Flexible duct connectors.
- F. Volume control dampers.

1.2 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- C. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- D. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- E. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. 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.
- B. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.4 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:

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1. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
 2. PCI Industries, Inc; Pottorff Brand; : www.portorff.com.
 3. Ruskin Company: www.ruskin.com/#sle.
 4. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.
- B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with worm drive mechanism with removable key operator.

2.2 BACKDRAFT DAMPERS

- A. Manufacturers:
1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 2. Nailor Industries, Inc: www.nailor.com/#sle.
 3. PCI Industries, Inc; Pottorff Brand : www.portorff.com.
 4. Ruskin Company: www.ruskin.com/#sle.
- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.3 DUCT ACCESS DOORS

- A. Manufacturers:
1. Nailor Industries, Inc: www.nailor.com/#sle.
 2. Ruskin Company: www.ruskin.com/#sle.
 3. SEMCO LLC: www.semcohvac.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.4 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.

2.5 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.6 VOLUME CONTROL DAMPERS

- A. Manufacturers:
1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 2. Nailor Industries, Inc: www.nailor.com/#sle.
 3. PCI Industries, Inc; Pottorff Brand : www.portorff.com.
 4. Ruskin Company: www.ruskin.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.

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- C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- D. 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.

PART 3 EXECUTION

3.1 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. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- 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 minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- 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

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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 REFERENCE STANDARDS

- A. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- B. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. 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.
- B. Manufacturer's Instructions: Indicate installation instructions.

1.4 FIELD CONDITIONS

- A. Request Owner permission to use permanent ventilator(s) for ventilation during construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Greenheck Fan Corporation: www.greenheck.com.
- B. Loren Cook Company: www.lorencook.com.

2.2 ROOF EXHAUSTERS

- A. 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.
- B. A backward-inclined, non-overloading centrifugal wheel to generate high efficiency and minimal sound.
- C. Roof Curb: 12 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- D. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

- E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- F. 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.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 - 1. Install flexible connections between fan and ductwork; see Section 23 33 00. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhausters fans and as indicated.

END OF SECTION

23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers:
- B. Rectangular ceiling diffusers.
- C. Registers/grilles:
 - 1. Ceiling-mounted, exhaust and return register/grilles.
 - 2. Ceiling-mounted, supply register/grilles.
- D. Fabric air distribution devices.

1.2 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2008.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.3 SUBMITTALS

- A. 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 sheets indicating materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

1.4 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Krueger: www.krueger-hvac.com.
- B. Price Industries: www.price-hvac.com.
- C. Titus: www.titus-hvac.com.

2.2 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square, adjustable pattern, stamped, multi-core diffuser to discharge air in four way pattern with sectorizing baffles where indicated.

B. Frame: T-Bar and Surface mount type. In plaster ceilings, provide plaster frame and ceiling frame. In T-Bar ceiling provide filler panel.

C. Fabrication: Steel with baked enamel off-white finish.

2.3 CEILING SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions with factory off-white enamel finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.4 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.5 FABRIC AIR DISTRIBUTION DEVICES

A. General Requirements:

1. Diffuser material to comply with ASTM E84, UL 723, UL 2518, NFPA 90A, and NFPA 90B.

2. Air Dispersion Method:

3. Hanger Supports:

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with airtight connection.

D. 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.

3.2 SCHEDULES SHOWN ON SHEET M-001

END OF SECTION

SECTION 23 81 26.13

SMALL CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air cooled condensing units.
- B. Indoor air handling (fan and coil) units for ducted systems.
- C. Controls.

1.2 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 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- E. ASHRAE Std 90.2 - Energy-Efficient Design of Low-Rise Residential Buildings; 2007, Including All Addenda.
- F. NFPA 54 - National Fuel Gas Code; 2024.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- I. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.
- J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- B. Design Data: Indicate refrigerant pipe sizing.
- C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- E. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.4 WARRANTY

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- A. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. York
- B. LG Air Conditioning Technologies
- C. Mitsubishi Electric: meus1.mylinkdrive.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. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
 - 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.
- C. Electrical Characteristics:
 - 1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 05 83.

2.3 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- B. 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. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Compressor: ARI 520; hermetic, two speed 1800 and 3600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

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- D. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).

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.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.
- E. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

SECTION 23 74 16

PACKAGED ROOFTOP AIR-CONDITIONING UNITS

PART 1 PRODUCTS

1.1 MANUFACTURERS

- A. York
- B. Aeon Corporation
- C. Substitutions: See Section 016000 - Product Requirements.

1.2 PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

- A. Manufacturers:
 - 1. York
 - 2. Aeon Corporation
 - 3. Substitutions: See Section 016000 - Product Requirements.
- B. General: Roof mounted units having gas burner and electric refrigeration that are 6 tons and smaller in capacity.
- C. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, heat recovery coil, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan, modulating economizer and modulating power exhaust.
- D. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

1.3 CASING

- A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver-operated flush, cam type fasteners. Structural members to be minimum 18 gauge, 0.0478 inch, with access doors or panels of minimum 20 gauge, 0.0359 inch.
- B. Evaporator fan cabinet interior shall be insulated with a minimum .5-in. thick, 1 lb. density, flexible fiberglass insulation. Insulation shall conform to AHRI 210/240 or 340/360 minimum exterior sweat criteria. Gas heat compartment shall use aluminum foil face fiberglass insulation.
- C. Cabinet panels shall be easily removable for servicing
- D. Unit shall have a factory-installed, sloped condensate drain pan made of a non-corrosive material, providing a minimum 3/4-in. connection with both vertical and horizontal drains and shall comply with ASHRAE 62

1.4 FANS

- A. Supply Fan: Forward curved centrifugal type, direct drive motor with ECM controls. Isolate complete fan assembly. See Section 230548.

1.5 BURNERS

- A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame-sensing device, and automatic 100 percent shutoff pilot.
- B. Shall be Ultra Low NOx, low gas heat
- C. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

1.6 EVAPORATOR COIL

- A. Evaporator coils shall have aluminum plate fins mechanically bonded to enhanced copper tubes with all joints brazed.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

1.7 CONDENSER COIL

- A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.
- C. Provide refrigerant pressure switches to cycle condenser fans.

1.8 COMPRESSORS

- A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.
- B. Factory rubber shock mounted vibration isolation
- C. Warranty for compressor shall be 5 years
- D. Five minute timed off circuit to delay compressor start.
- E. Outdoor thermostat to energize compressor above 35 degrees F ambient.

1.9 MIXED AIR CASING

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position. Relief dampers may be gravity balanced.
- B. Gaskets: Provide tight fitting dampers with edge gaskets maximum leakage 5 percent at 2-inch pressure differential.
- C. Damper Operator: 24 volts with gear train sealed in oil.
- D. Damper Operator: Pneumatic piston or gear driven type with spring return and pilot positioner.

- E. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and above 75 degrees F ambient, or when ambient air temperature exceeds return air temperature.

1.10 AIR FILTERS:

- A. 2-inch thick, MERV 13, glass fiber disposable media in metal frames. Filter face velocity shall not exceed 300 FPM.
- B. See Section 234000.

1.11 OPERATING CONTROLS

- A. Provide low voltage, adjustable room thermostat to control burner operation, compressor and condenser fan, and supply fan to maintain temperature setting.
 - 1. Include system selector switch heat-off-cool and auto-on fan control switch.
 - 2. Locate thermostat in room as indicated on drawings.

1.12 SAFETIES

- A. Compressor over temperature, over current
- B. Loss of charge/low pressure switch
- C. Evaporator coil freeze protection thermostat
- D. High Pressure switch
- E. High temperature limit switches, induced draft motor speed sensor, flame rollout switch, flame proving controls for heating section

1.13 ROOF CURBS

- A. Roof Mounting Curb: 14 inches high base, galvanized steel, channel frame with gaskets, and nailer strips.

1.14 MOTORS

- A. Compressor motors shall be cooled by refrigerant passing through motor windings and shall have line break thermal and current overload protection.
- B. Indoor blower (evaporator-fan) motor shall have permanently lubricated bearings and inherent automatic-reset thermal overload protection. Include direct or belt drive as shown on the equipment schedule
- C. Condenser-fan motor shall have permanently lubricated bearings and inherent automatic-reset thermal overload protection.
- D. Induced draft motor shall have permanently lubricated, sealed bearings and inherent automatic reset thermal overload protection.

PART 2 EXECUTION

2.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as required by manufacturer.
- B. Verify that proper power supply is available.

2.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 90A.
- C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- D. Locate remote panels where indicated on drawings.

2.3 SYSTEM STARTUP

- A. Prepare and start equipment. Adjust for proper operation.

2.4 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals for additional submittals.
- B. See Section 017900 - Demonstration and Training for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

2.5 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of packaged rooftop units for one year from Date of Substantial Completion.
- D. Provide routine maintenance service with a two-month interval as maximum time period between calls.
- E. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- F. Provide 24-hour emergency service on breakdowns and malfunctions.
- G. After each service call, submit copy of service call work order or report that includes description of work performed.

END OF SECTION

SECTION 26 0010
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents including Civil, Architectural, Structural, and Mechanical documents which may designate Work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
 - 1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
 - 1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.02 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
 - 1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 - 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.
- B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.
- C. Codes and Regulations:

1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE
 - b. National Electrical Manufacturers' Association - NEMA
 - c. Underwriters' Laboratories, Inc. - UL
 - d. National Fire Protection Association - NFPA
 - e. American Society for Testing and Materials - ASTM
 - f. American National Standards Institute - ANSI
 - g. California Electrical Code - CEC, Title 24, Part 3
 - h. California Code of Regulations, Title 8, Subchapter 5
 - i. California Building Code-CBC, Title 24 Parts 1 & 2
 - j. State & Municipal Codes in Force in the Specific Project Area
 - k. Occupational Safety & Health Administration - OSHA
 - l. California State Fire Marshal
 - m. California Fire Code- CFC, Title 24 Part 9
 - n. National Electrical Testing Association - NETA
 2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.
- D. Requirements of Regulatory Agencies:
1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.
- E. Shop Drawings:
1. See Division 01 for additional requirements.
 2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
 3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
 4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.
 5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated

spaces". Failure to add the above written statement for compliance will result in return of submittals without review.

- a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
- b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
- c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
- d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
- e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
- f. Reference listings to the specifications' Sections and Article to which each is applicable.
- g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.

6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.

F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.

G. Standard of Quality

1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.
2. Items for similar application shall be of the same manufacturer.
3. The label of listing by UL shall appear on all materials and equipment for which standards have been established by the agency.
4. Where codes as listed in Section General Requirement Section of the Specifications that establish label or approved requirements, furnish all materials and equipment with either the required labels affixed or the necessary written approval.
5. Provide the type and quantity of electrical materials and equipment necessary to complete Work and all systems in operation, tested and ready for use.
6. Provide and install all incidental items that belong to the Work described and which are required for complete systems.
7. All switchboards, distribution boards, panel boards and circuit breakers shall be of the same manufacturer.
8. All wiring devices such as switches and receptacles shall be of the same manufacturer.

H. Substitutions: Refer to Division 01

- I. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:
1. General Requirements:
 - a. Panelboards.
 - b. Conduits
 - c. Conductors, include all selected insulation types.
 - d. Fuses
 - e. Disconnect switches and Starters.
 - f. Pullboxes, manholes and handholes.
 - g. Standard lighting fixtures, specially fabricated fixtures, ballasts and lamps, with samples and sample of standard finish available (where requested).
 - h. Control devices, standard and special receptacles, switches, outlets and finish device plates.
 - i. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
 - j. Fire alarm system.
- J. Utility Service:
1. Contractor shall verify the locations shown on the drawings and shall include extensions of lines to building service from locations which are acceptable to the Owner.
 2. Verify electrical, civil, architectural and structural, dimensional and other requirements with the Owner.
 3. Should any major modifications to the work indicated be necessary to comply with the Owner requirements, notify the Architect.
- K. Record Drawings: Refer to Division 01, Contract Closeout.
- L. Work Responsibilities:
1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.
 2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
 3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
 4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
 5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
 6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
 7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.

8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.
- M. Installation General: For special requirements, refer to specific equipment under these requirements.
1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
 2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
 3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
 4. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
 5. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
 6. Protect work, materials and equipment and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.
 7. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
 8. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.
 9. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
 10. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
 11. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.
- N. Excavation, Cutting and Patching:
1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 2. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
 2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

- O. Tests
1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
 2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
 3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
 4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
 5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Owner's Representative. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
 6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
 7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.
- P. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.
- Q. Cleaning Up:
1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
 2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
 3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
 4. Leave the entire installation in a clean condition.
- R. Completion:
1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.

2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.
- S. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01
- T. Inspection and Acceptance Procedures: The Architect will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.
- U. Final Completion of Electrical Systems:
1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Furnish the required Operating and Maintenance Data/Manuals.
 - c. Clean up of the project pertaining to this Division of the work.
 - d. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Architect that systems are complete and operating in conformance with Contract Documents.
 - e. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - f. Submission of warranties and guarantees.
 2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.
 - b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Architect and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.
 - d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.
- V. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- W. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly

familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.03 PROJECT RECORD DOCUMENTS

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2012 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- C. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- D. Final Record Drawings: Conform to Division 01 requirements.
- E. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- F. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- G. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- H. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.
- I. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Refer to Division 01.
- J. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- K. Warranty Certificates: Comply with Division 01.

PART 2 - COMMISSIONING

2.01

Commissioning of Electrical Systems

- A. Include cost for commissioning requirements in the contract price.
- B. Attend commissioning meetings scheduled by the CxA.
- C. Prepare preliminary schedule for indoor lighting system inspections, O&M manual submission, training sessions, lighting controls testing, system verification, performance testing, and system completion for use by the CxA. Update schedule as appropriate throughout the construction period and provide updated schedule to the commissioning team.
- D. Verify proper installation and performance of all electrical services provided.
- E. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup of HVAC and electrical equipment.
 - 1. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Make Certificate(s) of Installation available for CxA review upon request.
 - 3. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.
 - 1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 - 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as California Advanced Lighting Controls Training Program Acceptance Technician (CALCTP-AT) employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Participate in the Certificate(s) of Acceptance and Functional Performance Tests as required to achieve design intent.
- I. Participate in the opposite-season testing as required to achieve design intent.
- J. Participate in O&M Training as required by project specifications.
- K. Ensure participation of major equipment manufacturers and their representatives as applicable.
- L. Obtain O&M data on all equipment and assemble in binders using tabs as required.
- M. Conduct a maintenance orientation and inspection with hands on training per the contract documents.
- N. Provide written certification and completed Certificate(s) of Installation forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed.
 - 1. Correct labeling of all circuits with connected equipment.

2. Lighting system controls operations, including occupancy sensors, automatic time controls or Energy Management control, override timers, manual dimming controls, exterior lighting controls, multi-level switching, as applicable to the Work.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Wire pulling lubricant.
- F. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 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. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds Most Recent Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- Q. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables Current Edition, Including All Revisions.
- R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

1.04 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 with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. 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.
- B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 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. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

2.02 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. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. 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.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- I. 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.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.

- 4) 20A exterior circuits: 10 AWG..
- 2. Control Circuits: 14 AWG.
- J. 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.

2.03 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. Southwire Company: www.southwire.com/#sle.
 - d. Rome Wire and Cable.
 - e. Okonite Wire
 - f. Pirelli Wire and Cable
 - g. Carol Cable
- 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.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.

2.04 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. 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.
- C. 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. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. 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.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.05 ACCESSORIES

- A. Electrical Tape:
1. 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.
 2. 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.
 3. 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.
 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 5. 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.

- C. Wire Pulling Lubricant:
 - 1. Listed and labeled as complying with UL 267.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 - EXECUTION

3.01 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 field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean and mandrel raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 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 not permitted.
 - 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- 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.
- 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 260553.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section Firestopping.
- Q. 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.

3.04 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.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Section 096500 - Resilient Flooring: Static control flooring.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.04 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 Architect 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.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Field quality control test reports.
- C. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 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 Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- 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. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
 5. Ground Rod Electrode(s):
 - a. Provide two electrodes unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Provide ground access well for each electrode.
 6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 7. 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 2 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. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- I. 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.
- J. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.

- c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

2.02 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 260526:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- 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.
 - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
- 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.
- E. Ground Rod Electrodes:
 - 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
- F. Ground Access Wells:
 - 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 - 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 - 4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. 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 install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
- D. 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.
- E. Identify grounding and bonding system components in accordance with Section 260553.

3.03 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. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

3.04

**SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. **Support and attachment** requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 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 2019.
- 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.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 033000.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, 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 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 and clamps suitable for 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.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
 - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 2. Comply with MFMA-4.
 - 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.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 2. New Concrete: Use preset concrete inserts.
 - 3. Existing Concrete: Use expansion anchors.
 - 4. Solid or Grout-Filled Masonry: Use expansion anchors.
 - 5. Hollow Masonry: Use toggle bolts.
 - 6. Hollow Stud Walls: Use toggle bolts.
 - 7. Steel: Use welded threaded studs complying with AWS D1.1/D1.1M with lock washers and nuts or Beam clamps (MSS Type 19 21 23 25 or 27) complying with MSS SP-69.
 - 8. Sheet Metal: Use sheet metal screws.
 - 9. Wood: Fasten with lag screws or through bolts.
 - 10. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
 - 11. Plastic and lead anchors are not permitted.
 - 12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.
 - 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- 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 in accordance with manufacturer's recommended torque settings.
- K. Remove temporary supports.

3.03 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete unless otherwise noted in the drawings. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete or Cast-in-Place Concrete (Limited Applications)" as applicable.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturers written instructions.

3.04 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 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.
- G. Reinforced thermosetting resin conduit (RTRC).

1.02 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. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
- E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
- G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- H. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series 2015.
- I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
- K. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- L. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.

- M. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- N. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
- O. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 - 5. Notify Architect of 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 between termination points is complete.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Documents: Record actual routing for conduits installed underground and conduits 2 inch (53 mm) trade size and larger.

1.05 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:

1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
 4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
 5. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 6. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
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.
- J. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.
- L. Corrosive Locations Above Ground: Use stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), stainless steel electrical metallic tubing (EMT), or reinforced thermosetting resin conduit (RTRC).
- M. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).

- N. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- O. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch trade size.
 - 3. Control Circuits: 1/2-inch trade size.
 - 4. Flexible Connections to Luminaires: 3/8-inch trade size.
 - 5. Underground, Exterior: 1-inch trade size.
- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
- C. PVC-Coated Boxes and Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 - 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 - 4. Material: Use steel or malleable iron.
 - 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.05 FLEXIBLE METAL CONDUIT (FMC)

- A. 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.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.08 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: As recommended by manufacturer.

- C. Fittings: Same type and manufacturer as conduit to be connected.

2.09 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- E. 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 conduits unless specifically indicated to be exposed.
 - 4. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 5. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 6. Arrange conduit to provide no more than equivalent of three 90-degree bends between pull points.
 - 7. Arrange conduit to provide no more than 150 feet between pull points.
 - 8. Route conduits above water and drain piping where possible.
 - 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 11. 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.
 12. Group parallel conduits in same area on common rack.
- F. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. 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.
 4. 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.
 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 9. Use of spring steel conduit clips for support of conduits is not permitted.
 10. Use of wire for support of conduits is not permitted.
- G. 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. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 7. Secure joints and connections to provide mechanical strength and electrical continuity.
- H. 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. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 6. 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.
 7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.
- I. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 2. Provide underground warning tape in accordance with Section 260553 along entire conduit length.
- J. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section Concrete with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- K. 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 conduits are subject to earth movement by settlement or frost.
- L. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 24 inches at each end.
- N. Provide grounding and bonding; see Section 260526.
- O. Identify conduits; see Section 260553.

3.03 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.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 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.

END OF SECTION

SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.02 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. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

1.03 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 Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for floor boxes and underground boxes/enclosures.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 - PRODUCTS

2.01 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 suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. 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.

11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 12. 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.
 13. Wall Plates: Comply with Section 262726.
- 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. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 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.

PART 3 - EXECUTION

3.01 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. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section Access Panels 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 262726.
 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 260533.13.
 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.
- H. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 2. 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.
- I. Install boxes plumb and level.
- J. 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.
- K. Install boxes as required to preserve insulation integrity.

- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 260526.

3.02 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.03 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.
- E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating, name and source.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
 - 2. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
 - 3. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal

protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure 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.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

C. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
4. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.
2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 262726.
2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
3. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02

IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 - 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend:
 - a. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
 - 5. Color:
 - a. Normal Power System: White text on black background.
- D. Format for Caution and Warning Messages:
 - 1. Minimum Size: 2 inches by 4 inches.
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/2 inch.
 - 5. Color: Black text on yellow background unless otherwise indicated.
- E. Format for Receptacle Identification:
 - 1. Minimum Size: 3/8 inch by 1.5 inches.
 - 2. Legend: Power source and circuit number or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch.
 - 5. Color: Black text on clear background.

- F. Format for Control Device Identification:
 - 1. Minimum Size: 3/8 inch by 1.5 inches.
 - 2. Legend: Load controlled or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch.
 - 5. Color: Black text on clear background.

2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 - 1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 - 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
- E. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:

2.06 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Enclosure front.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 2726 WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.02 RELATED REQUIREMENTS

- A. Section 260533.16 - Boxes for Electrical Systems.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification) 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

1.04 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. Notify Architect of any conflicts or deviations from 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.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Hubbell Incorporated: www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc: www.leviton.com.
- C. Lutron Electronics Company, Inc: www.lutron.com.
- D. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

2.02 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles.
- E. Provide GFCI protection for receptacles installed within 6 feet of sinks.

- F. Provide GFCI protection for receptacles serving electric drinking fountains.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.

2.03 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

2.04 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Switches - General Requirements: 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.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.05 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. Receptacles - General Requirements: 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.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
 3. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.06 WALL PLATES

- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com.
 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 3. Lutron Electronics Company, Inc: www.lutron.com.
 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- E. 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 and identified as extra-duty type.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- 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 wall openings are neatly cut and will be completely covered by 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 wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 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.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. 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.
 - 4. 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 Architect to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. 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.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

- I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. 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.
- N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- O. Identify wiring devices in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

**SECTION 26 2813
FUSES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Fuses.

1.02 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.
- D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.05 QUALITY ASSURANCE

- A. Comply with 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

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.
- B. Littelfuse, Inc: www.littelfuse.com.

- C. Mersen: ep-us.mersen.com.

2.02 APPLICATIONS

- A. Individual Motor Branch Circuits: Class RK1, time-delay.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

**SECTION 26 2816.16
ENCLOSED SWITCHES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 262813 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within 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. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
- C. Project Record Documents: Record actual locations of enclosed switches.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Siemens Industry, Inc: www.usa.siemens.com.
- E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.03 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 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUMMARY

- A. This Section includes Fire alarm system design and installation, including all components, wiring, and conduit.

1.04 DEFINITIONS

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. Definitions in NFPA 72, 2022 Edition, apply to fire alarm terms used in this Section.

1.05 SYSTEM DESCRIPTION

- A. Existing Fire Alarm Control Panel is an Edwards EST3 addressable system.
 - 1. New notification and initiating devices shall interface with existing panel.

1.06 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72, 2022 Edition, CBC, CFC & Titles 19 and 24 CCR.
- B. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Verified automatic alarm operation of smoke detectors.
 - 5. Automatic sprinkler system water flow.
 - 6. Fire extinguishing system operation.
 - 7. Fire standpipe system.

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- C. Fire alarm signal shall initiate the following actions:
 - 1. Alarm notification appliances shall operate continuously.
 - 2. Identify alarm at the FACP and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
 - 7. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
 - 8. Record events in the system memory.
 - 9. Record events by the system printer.
- D. Supervisory signal initiation shall be by one or more of the following devices or actions:
 - 1. Operation of a fire-protection system valve tamper.
- E. System trouble signal initiation shall be by one or more of the following devices or actions:
 - 1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
 - 2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of primary power at the FACP.
 - 4. Ground or a single break in FACP internal circuits.
 - 5. Abnormal ac voltage at the FACP.
 - 6. A break in standby battery circuitry.
 - 7. Failure of battery charging.
 - 8. Abnormal position of any switch at the FACP or annunciator.
 - 9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- F. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators. Record the event on system printer.

1.07 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire alarm system design.
 - b. Fire alarm certified by NICET, minimum Level III.
 - 2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 - 3. Device Address List: Coordinate with final system programming.
 - 4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
 - 5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
 - 6. Batteries: Size calculations.

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7. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.
- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 01 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
- G. Documentation:
 1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
 - a. Hard copies on paper to Owner, Architect, and authorities having jurisdiction.
 - b. Electronic media may be provided to Architect and authorities having jurisdiction.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.09 PROJECT CONDITIONS

- A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify Architect no fewer than fourteen days in advance of proposed interruption of fire alarm service.
 2. Do not proceed with interruption of fire alarm service without Architect's and Owner's written permission.

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.
 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 3. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.

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5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Existing FACP and Equipment:
 - a. Edwards (EST3)
 2. Wire and Cable:
 - a. West Penn Wire/CDT; a division of Cable Design Technologies or equal.
 3. Audible and Visual Signals:
 - a. Edwards – Genesis Series

2.02 FACP

- A. General Description:
 1. Modular, power-limited design with electronic modules, UL 864 listed.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 1. Signaling Line Circuits: NFPA 72, Class B, Style 0.5.
 2. System Layout: Install no more than 100 addressable devices on each signaling line circuit.
 3. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
 4. Actuation of alarm notification appliances, annunciation, smoke control, elevator recall, and actuation of suppression systems shall occur within 20 seconds after the activation of an initiating device.
 5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.
- D. Smoke-Alarm Verification:
 1. Initiate audible and visible indication of an "alarm verification" signal

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2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel FACP indication and system reset if the alarm is not verified.
- E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.
- F. Elevator Controls: Heat detector operation shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.
- G. Elevator Controls: Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.
1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.
- H. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.
- I. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.
1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- J. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- K. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.
- L. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
- M. Service Modem: Ports shall be RS-232 for system printer and for connection to a dial-in terminal unit.
1. The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.
- N. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

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- O. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter and digital alarm radio transmitter shall be powered by the 24-V dc source.
 - 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
 - 2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."
- P. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
 - 1. Batteries: Sealed lead calcium or Sealed, valve-regulated, recombinant lead acid.
 - 2. Battery and Charger Capacity: Comply with NFPA 72.
- Q. Surge Protection:
 - 1. Install surge protection on normal ac power for the FACP and its accessories.
 - 2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
- R. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.03 MANUAL FIRE ALARM BOXES

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, breaking-glass or plastic-rod or pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 - 2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod or pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 - 3. Station Reset: Key- or wrench-operated switch.
 - 4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.04 SYSTEM SMOKE DETECTORS

- A. General Description:
 - 1. UL 268 listed, operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - 3. Multipurpose type, containing the following:
 - a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - b. Piezoelectric sounder rated at 88 dBA at 10 feet (3 m) according to UL 464

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- c. Heat sensor, combination rate-of-rise and fixed temperature.
- 4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
- 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
- 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
 - a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
 - 1. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - 2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

2.05 HEAT DETECTORS

- A. General: UL 521 listed.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.
 - 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
 - 1. Mounting: Adapter plate for outlet box mounting or Plug-in base, interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.06 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
 - 2. Revise sound-level values in first four paragraphs below to comply with local interpretations of ADA requirements. See Editing Instruction No. 10 in the Evaluations.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn.
- C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

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1. Rated Light Output: candela as indicated on drawings.
2. Strobe Leads: Factory connected to screw terminals.

2.07 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between the FACP, the Fire Command Center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
 1. Common-talk type for firefighter use only.
 2. Selective-talk type for use by firefighters and fire wardens.
 3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
 4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
 5. Selector panel controls simultaneous operation of telephones in selected zones and permits up to six phones to be operated simultaneously. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
 6. Provide liquid-crystal digital display to indicate location of caller.
 7. Remote Telephone Cabinet: Flush or surface-mounted cabinet, as indicated, factory-standard red finish, with handset.
 8. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Warden Phone" or "Fire Emergency Phone."
 - a. With "break-glass" type door access lock.
 9. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Warden Phone" or "Fire Emergency Phone."
 10. Handsets: Provide push-to-talk type sets with noise-canceling microphone. Provide 10 handsets stored in a cabinet adjacent to the FACP.

2.08 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
 1. Mounting: Flush cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.09 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall and to a circuit-breaker shunt trip for power shutdown.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if :

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interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 GUARDS FOR PHYSICAL PROTECTION

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of the device.
 - 2. Finish: Paint of color to match the protected device.

2.12 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with CEC, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, No. 14 AWG or as indicated on drawings.
 - 1. Circuit Integrity Cable: Twisted shielded pair, CEC Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Smoke or Heat Detector Spacing:
 - 1. Smooth ceiling spacing shall not exceed 30 feet (9 m) and the rating of the detector.
 - 2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
 - 3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
- B. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
- C. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- D. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- E. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- F. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- G. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

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- H. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.02 WIRING INSTALLATION

- A. Install wiring according to the following:
 - 1. NECA 1.
 - 2. TIA/EIA 568-A.
 - 3. CEC
- B. Wiring Method: Install wiring in metal raceway according to Section 26 05 33.13 - Conduit for Electrical Systems
 - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Section 26 05 53 - Identification for Electrical Systems.
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

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- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
 - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - 3. Include the existing system in tests and inspections.
 - 4. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - 5. Testing: Follow procedure and record results complying with requirements in NFPA 72.
 - 6. Detectors that are outside their marked sensitivity range shall be replaced.
 - 7. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in CEC.

3.06 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.
- C. Work in two paragraphs below is normally the responsibility of Owner. Retain one or both paragraphs if Owner needs additional time for inspections required by NFPA 72.
- D. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- E. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 01 Section "Demonstration and Training."

3.08 DOCUMENTATION

- A. Provide an NFPA Certificate of compliance to DSA, the School District, Local Fire Marshal, and Architect.

END OF SECTION

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