100% CONSTRUCTION

DSA Application: 02-120270
File: 34-70

Babcock ES HVAC MOD - Phase 2

2400 Cormorant Way, Sacramento, CA 95815

3543003

Twin Rivers Unified School District

3222 Winona Way, Suite 201, North Highlands, CA 95660

June 24, 2022

HMC Architects

Babcock ES HVAC MOD - Phase 2
Twin Rivers Unified School District
North Highlands, CA

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 02-120270 INC:
REVIEWED FOR
SS ☑ FLS ☑ ACS ☐
DATE: 10/31/2022

June 24, 2022
HMC # 3543003
DSA # 02-120270
File 34-70

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SECTION 00 01 10

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CALGREEN REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes general requirements and procedures for compliance with 2019 CALGreen nonresidential mandatory requirements.

B. Related Sections:
   1. Divisions 01 through 33 Sections, as applicable, for CALGreen requirements specific to the work of each of those Sections.

1.02 SUBMITTALS

A. CALGreen submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated CALGreen requirements.

B. Contractor shall develop a spreadsheet to track submittals required by CALGreen.

C. CALGreen Submittals:
   1. Furnish documentation showing verification of CALGreen compliance as required by Division of the State Architect - Structural Safety (DSA-SS).
   2. Section 5.106.1 - Storm Water Loss Prevention Plan: Newly constructed projects and additions which disturb less than one acre of land shall prevent the pollution of stormwater runoff from the construction activities through one or more of the following measures:
      a. Local ordinance, 5.106.1.2.
      b. Best management practices (BMP) complying with Section 5.106.1.2.
   3. Section 5.106.10 - Grading and Paving: Furnish drawing showing grading and paving designed to keep surface water from entering buildings.
   4. Section 5.408.1.4 - Construction Waste Management Plan: Furnish a construction waste management plan complying with specified requirements.
   5. Section 5.504.4.3.2 Verification - Contractor to verify if this section is requested by DSA. Documentation may include, but is not limited to, the following:
      a. Manufacturer's product specification, and
      b. Field verification of on-site product containers.
   6. Section 5.504.4.5.3 - Composite Wood Products: Furnish documentation showing compliance with Section 5.504.4.5.
   7. Section 5.504.5.6.1 - Resilient Flooring: Furnish documentation showing resilient flooring materials meet the pollutant emission limits.

1.03 SUMMARY OF CALGREEN REQUIREMENTS

A. Division 5.1 - Planning and Design:
   1. Section 5.106.4 - Bicycle Parking: Comply with Section 5.106.4.2, as applicable, for short-term and long-term bicycle parking.

2. Section 5.106.8 - Light Pollution Reduction: Comply with Section 5.106.8.1 for outdoor lighting systems.

B. Division 5.3 - Water Efficiency and Conservation:
   1. Section 5.304.6 - Outdoor potable water use in landscape areas: Comply with Section 5.304.6.1 and 5.304.6.2, California Department of Water Resources Model Water Efficient Landscape Ordinance (MWELO).

C. Division 5.4 - Material Conservation and Resource Efficiency:
   1. Section 5.407 - Water Resistance and Moisture Management: Comply with requirements specified in Section 5.407 for Weather Protection and Moisture Control.
   2. Section 5.408 - Construction Waste Reduction, Disposal and Recycling: Comply with requirements specified in Section 5.408.1.
      a. Recycled and/or salvage for reuse a minimum of 65-percent of the nonhazardous construction and demolition waste or meet a local construction and demolition waste management ordinance, whichever is more stringent.
      b. Where the local jurisdiction does not have a construction and demolition waste management ordinance, submit a construction waste management plan with the following:
         1) Identify the materials to be diverted from disposal by efficient usage, recycling, reuse on the Project or salvage for future use or sale.
         2) Determine if materials will be sorted on-site or mixed.
         3) Identify diversion facilities where material collected will be taken.
         4) Indicate the amount of materials diverted, calculated by weight or volume, but not by both.
      c. Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with Section 5.408.1.2.
      d. The combined weight of new construction disposal that does not exceed 2-pounds per sq. ft. of building area may be deemed to meet the 65-percent minimum requirement.
      e. Documentation shall be provided to the enforcing agency which demonstrated compliance with Section 5.408.1 thru 5.408.1.3. The waste management plan shall be updated as required and shall be accessible during construction for examination by the enforcing agency.
      f. 100-percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled.
      g. 5.408.1.4 - Documentation: Documentation shall be provided to DSA which demonstrates compliance with Sections 5.408.1.1 through 5.408.1.3.
   3. Section 5.410 - Building Maintenance and Operation: Comply with the requirements specified in Section 5.410.
      a. Provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of non-hazardous materials for recycling, including paper, corrugated cardboard, glass, plastics and metals.

b. For new buildings of 10,000-sq. ft. or more, comply with the commissioning requirements specified in Section 5.410.2. Commissioning shall be performed by trained personnel with experience on projects of comparable size and complexity. General commissioning requirements include the following. The specific requirements of each item are specified in Section 5.410.2.1 thru 5.410.2.6.
   1) Owner's or Owner Representative's project requirements.
   2) Basis of design.
   3) Commissioning measures shown in the Construction Documents.
   4) Commissioning plan.
   5) Functional performance testing.
   6) Documentation and training.
   7) Commissioning report.

c. For new buildings less than 10,000-sq. ft., test and adjust systems as specified in Sections 5.410.4.2 thru 5.410.4.5.

D. Division 5.5 - Environmental Quality:
   1. Section 5.504 - Pollutant Control: Comply with the requirements specified in Section 5.504.
      a. Cover duct openings and protect mechanical equipment during construction as specified in Section 5.504.3.
      b. Finish materials shall comply with the requirement specified in Sections 5.504.4.1 thru 5.504.4.4, as follows:
         1) Adhesives, adhesive bonding primers, adhesive primers and caulks shall meet the following requirements:
            a) Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable or SCAQMD Rule 1168 VOC limits as shown in Tables 5.504.4.1 and 5.504.2.
            b) Aerosol adhesives and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
         2) Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3 unless more stringent local limits apply.
            a) Aerosol paints and coatings shall meet the PWMIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, ion Sections 94522(c)(2) and (d)(2) of CCR, Title 17, commencing with Section 94520 and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8 Rule 49.
         3) Carpet shall meet the testing and product requirements of one of the following, as required by Section 5.504.4.4:
            a) Carpet and Rug Institute's Green Label Plus Program.

b) California Department of Public Health Standard Practice for the testing of VOCs (Specification 01350).
c) NSF/ANSI 140 at the Gold level.
d) Scientific Certifications Systems Sustainable Choice.
e) California Collaborative for High Performance Schools (CA-CHPS) and listed in the CHPS High Performance Product Database.

4) Carpet cushion shall meet the requirements of the Carpet and Rug Institute Green Label program.
5) Carpet adhesive shall meet the requirements of Table 5.504.4.1.
6) Composite wood products, including hardwood plywood, particleboard and medium density fiberboard, used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et seq.) by or before the dates specified in those sections, as shown in Table 5.504.4.5.
7) For 80% of floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:
a) Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program.
b) Compliant with the VOC emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
c) Compliant with California Collaborative for High Performance Schools (CA-CHPS) Criteria Interpretation for EQ2.2 dated July 2012 and listed in CHPS High Performance Product Database.
d) Compliant with CDPH criteria as certified under the Greenguard Children's & Schools Programs.

c. Provide regularly occupied areas of the building with air filtration media for outside and return air prior to occupancy that provides at least a MERV of 13 as specified in Section 5.504.5.3.
d. Where outdoor areas are provided for smoking, prohibit smoking within 25-feet of building entries, outdoor air intakes and operable windows and in buildings; or as enforced by ordinances, regulations or policies of any city or county, whichever are more stringent. Post signage to inform building occupants of the prohibitions.

2. Indoor Moisture Control: Comply with the requirements specified in Section 5.505.
3. Indoor Air Quality: Comply with the requirements specified in Section 5.506.
4. Environmental Comfort: Comply with the requirements specified in Section 5.507.
5. Outdoor Air Quality: Comply with the requirements specified in Section 5.508.

E. Summary:
1. Certain CALGreen Measures needed to comply with code are dependent on material selections, documentation and means and methods of the work. Each item related to CALGreen may not be specifically identified as CALGreen requirements in this Section. Refer to CALGreen Code, CCR Title 24, Part 11 for complete descriptions of measures and submittal requirements.

2. Designate an onsite field staff person contact for all CALGreen prerequisites and credit documentation, subcontractor supervision and submittal coordination and to manage the Contractor's portions of the CALGreen submittal process.
3. Documentation for CALGreen Measures shall be submitted in the format required by the CALGreen code.
4. A copy of the CALGreen code, CCR Title 24, Part 11 shall be available on-site at all times.
5. Additional information on CALGreen can be found at http://www.bsc.ca.gov.

F. Meetings:
1. Contractor shall conduct CALGreen compliance meetings as required. Contractor personnel who shall attend CALGreen compliance meetings include, but are not limited to:
   a. Contractor's project manager.
   b. Owner's Representative.
   c. Other attendees designated by Owner's Representative.
   d. Subcontractor representatives as appropriate to stage of work.
2. At a minimum, CALGreen compliance issues shall be discussed at the following meetings:
   a. Preconstruction meetings.
   b. Progress meetings.
   c. Subcontractor meetings.
   d. Meetings shall be scheduled as part of regularly scheduled job meetings on-site.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Field engineering and surveying.

B. Requirements and limitations for cutting and patching of Work.

C. Cleaning throughout construction period.

D. Project Record Documents.

E. Closeout procedures.

F. Adjusting.

G. Operation and maintenance data.

H. Warranty and Guarantee.

I. Spare parts and maintenance materials.

J. Instruction to Owner's personnel.

1.02 FIELD ENGINEERING QUALITY CONTROL

A. Employ Land Surveyor registered in the State of California and acceptable to Architect.
   1. Provide Certification of Compliance for required pool lengths in accordance with USA swimming regulations. Submit the completed form to USA Swimming National Events Department and provide copies to Owner and Architect.

B. Submit name, address and telephone number of Surveyor before starting survey work.

C. Maintain complete and accurate log of control and survey Work as it progresses.

D. On completion of foundation walls, floor slabs and major site improvements, prepare a certified survey illustrating dimensions, locations, angles and elevations of construction.

1.03 SURVEY REFERENCE POINTS

A. Contractor to locate and protect survey control and reference points.

B. Control datum for survey is that established by Owner provided survey.

C. Protect survey control points prior to starting site Work; preserve permanent reference points during construction.

D. Promptly report to the Architect loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to the Architect.

1.04 SURVEY REQUIREMENTS

A. Provide field engineering services. Use recognized engineering survey practices.

B. Establish a minimum of two permanent 3-inch diameter brass plate benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data on Project Record Documents. Establish additional temporary benchmarks at all floor levels.

C. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means, make use of laser instrumentation. Contractor shall arrange and pay for Field Engineering and Staking.
   1. Site improvements including pavements; stakes for grading, fill placement; utility locations, slopes, invert elevations and batter boards.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
   4. Floor elevations of existing structures that relate to project.
   5. Partition layouts on rough floor as a guide to all trades.

D. Periodically verify layouts by same means.

1.05 LAYOUT MARKINGS

A. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

1.06 CUTTING AND PATCHING

A. Where Work requires that particular existing building element such as partition, wall, paving, window, or similar element of existing building construction be removed, it is the intention of this Specification that such Work be part of the Demolition Section and not part of Cutting and Patching.

B. New Work required to replace such removals is considered as part of separate sections of Specifications covering similar new construction.

C. Where incidental cutting and patching is required for installation of a specific item or piece of equipment (including piping, ductwork, conduit, etc.), such cutting and patching is considered to be specified as part of that Section.

D. Contractor shall verify and check areas to be cut and patched and shall coordinate Work of various trades involved.

E. Where doubt exists as to size, location, or method of cutting concrete or any other structural element, including metal stud framing, Contractor shall contact Architect before proceeding.

F. Where doubt exists, Contractor shall distinguish between "cutting" and "demolition".

G. Unless specifically indicated otherwise, existing Work cut, altered, or revised to accommodate new Work shall be patched to duplicate undisturbed adjacent finishes, colors, textures, and profiles. New Work in existing portions shall also be finished to match adjacent existing Work unless noted otherwise.

H. Submit written request in advance of cutting or alteration which affects any of the following:
1. Structural integrity of any element of Project.
2. Integrity of weather-exposed or moisture-resistant element.
3. Efficiency, maintenance or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.
6. Coordinated Drawings in accordance with Section 01 30 00, Administrative Requirements.

I. Include in request:
1. Identification of Project.
2. Location and description of affected Work.
3. Necessity for cutting or alteration.
4. Description of proposed Work and products to be used.
5. Alternatives to cutting and patching.
6. Effect on Work of Owner or separate Contractor.
7. Written permission of affected separate Contractor.
8. Date and time Work will be executed.

1.07 QUALITY ASSURANCE - CLEANING

A. Inspection: Conduct daily inspection, and more often if necessary, to verify that requirements of cleanliness are being met.

B. Codes and Standards: In addition to requirements specified herein, comply with pertinent requirements of authorities having jurisdiction.

C. For final cleaning, use only professional cleaning company experienced in commercial cleaning.

1.08 PAYMENT WITHHELD - CLEANING

A. Architect reserves right to withhold certification of payment requests for failure on part of Contractor to regularly clean Project in conformance with Requirements of this Section.

1.09 CLOSEOUT PROCEDURES

A. Owner Occupancy:

1. Conform to Part 1, Title 24, Section 4-336 CCR Requirements for Verified Reports and Closeout Procedures.
2. In conjunction with Project Inspector, Contractor shall prepare list of items (Punchlist) to be completed or corrected. List may be developed by areas when approved by Architect.
3. Within time specified in the Certificate for Substantial completion after receipt of list, Architect will inspect to determine status of completion.
4. Should Architect determine that Work is not complete:
   a. Architect will promptly notify Contractor in writing, giving reasons for his determination.
   b. Contractor shall remedy deficiencies and notify Architect when Work is ready for re-inspection.
   c. Architect will re-inspect Work.
5. When Architect concurs that Work is substantially complete and ready for occupancy.
   a. Owner will prepare the Notice of Completion accompanied by Contractor's list (Punchlist) of items to be completed or corrected as verified by Architect.
   b. The Certified Notice of Completion will be submitted to the Owner and to Contractor for their written acceptance of responsibilities assigned to them in such notice.
   c. Contractor shall provide consent by insurer for Partial or Beneficial Occupancy.

B. Final Completion:
1. Prepare and submit notice that Work is ready for final inspection and acceptance.
2. Verify Work is complete.
3. Clarify that:
   a. Work has been inspected by all governing agencies and is in compliance with Contract Documents.
   b. Work has been completed in accordance with Contract Documents.
   c. Equipment and systems have been tested as required and are operational.
   d. Work is completed and ready for final inspection.
4. Architect will make an inspection to verify status of completion.
5. Should Architect determine Work is incomplete or defective:
   a. Architect will promptly notify Contractor in writing, listing incomplete or defective Work.
   b. Contractor shall remedy deficiencies promptly and notify Architect when ready for re-inspection.
6. When Architect determines Work is acceptable under the Contract Documents, he will request Contractor to make closeout submittals.

C. Closeout Submittals include, but are not necessarily limited to:
1. Project Record Documents.
2. Operation and maintenance data for items so listed in pertinent Sections of these Specifications and for other items when so approved by Architect.
3. Warranties and Guarantees.
4. Keys and keying schedule.
5. Spare parts, materials, extra stock to be turned over to Owner.
6. Evidence of payment and release of Stop Notices, when requested by Owner.

7. List of subcontractors, service organizations and principal vendors, including names, addresses and telephone numbers, where they may be contacted for emergency service at all times, including nights, weekends and holidays.
8. Notification of insurer for completion of Project.
9. Final Site Survey.
10. As condition precedent to Final Payment, submit documentation identifying amounts paid to Disabled Veteran Business Enterprises DVBE.

D. Final Payment:
1. Submit Final Payment Request, showing all adjustments to Contract Sum.
2. Retention will be released no sooner than 35 days after Notice of Completion has been recorded with County Recorders Office.

1.10 ADJUSTING

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

1.11 PROJECT RECORD DOCUMENTS

A. Record Documents: As-Built Drawings, Project Manual with Specifications including but not limited to the documents required herein.

B. Owner will provide [digital copy] [one set] of drawings and [one copy of] Project Manual for use during construction to record changes made during construction.

C. Record Documents: As-Built drawings and Project Manual, record in concise manner using industry-standard drafting techniques on drawings, on weekly basis all actual revisions to Work [and transfer as-built information to Auto CAD drawings at the completion of the project].
1. Changes made on Drawings, including Clarification Drawings.
2. Changes made to Specifications.
3. Changes made by Addenda.
4. Changes made by Construction Change Directives/Instruction Bulletins, Architect's Supplemental Instructions, minor changes.
5. Change Orders or other authorized Modifications to Contract.
6. Revisions made to shop drawings, product data and samples.

D. Store Record Documents separate from documents used for construction. Replace soiled or illegible documents.

E. Record information concurrent with construction progress.

F. Specifications: Legibly mark and record at each product Section description of actual products installed, including following:
1. Manufacturer's name, trade name, product model and number and supplier.
2. Authorized product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

G. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements. Identify drains and sewers by invert elevation.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of Work. Identify ducts, dampers, valves, access doors and control equipment wiring.
4. Field changes of dimension and detail.
5. Details not on original drawings.

H. Obtain Architect's signed certification that Record Documents have been fully updated prior to submitting monthly payment requests. Compliance is mandatory before payment will be made.

I. Submit Record Documents certified by Inspector to Architect with claim for final Application for Payment. Fully completed Record Documents are a prerequisite to final payment.

J. RECORD DRAWINGS: In addition to the As-Built Drawings required by this Section, upon completion of Work obtain a set of Project's reproducible drawings from Owner's Representative, incorporate all changes from the As-Built Drawings onto the Record Drawing set. Include all Change Orders, Addenda, Field Orders and as-installed conditions. All changes shall be neatly and legibly drawn to scale using standard architectural or engineering drafting practices. Identify set as "RECORD DRAWINGS". Deliver to Architect, (1) electronic (CD) copy, (1) field set, and one bond (hard) copy.

1.12 FORMAT OF OPERATION AND MAINTENANCE DATA

A. Manuals, Electronic Files: Submit manuals in the form of a combined electronic PDF file for each type of manual type required and shall include the following format:
1. Electronic Files: Use electronic files prepared by the manufacturer where available. When scanning of paper documents is required, configure scanned file for minimum readable file size.
2. Cover Page with the following listed information:
   a. Owner's Information.
   b. Project Name.
   c. Contractor's Information.
   d. Volume Number, as required.
   e. CSI Divisions contained in manual.
3. Cover Page for each Specification Section which includes:
   a. CSI Specification Section Name and Number.
4. Bookmarks: Individual documents shall be bookmarked according to file name. Name document file names to correspond to the following:
   a. CSI Specification Section Name and Number as indicated on the Project Manual Table of Contents.
   b. System, subsystem, or equipment name that is under the corresponding CSI Specification Section Name.
5. Table of Contents: List each CSI Specification Section Number and Name that is listed in the manual on the Table of Contents. Hyperlink the CSI Specification Section and Number listed in the Table of Contents to the corresponding Cover Page for that Specification Section.

1.13 WARRANTY AND GUARANTEE

A. Contractor, manufacturer's warranties and guarantees not withstanding, warrants entire Work against defects in materials and workmanship for twelve (12) months from date of [Certified Notice of Completion] [Certified Substantial Completion]. Warranties and guarantees between Contractor and manufacturers and Contractor and suppliers shall not affect warranties or guarantees between Contractor and Owner. Refer to General and Supplementary Conditions for additional requirements.

B. Execute and assemble documents from subcontractors, suppliers and manufacturers.

C. Submit prior to final Application for Payment.

D. For items of Work delayed beyond date of Notice of Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of Guarantee Period.

1.14 WARRANTIES - FORM OF SUBMITTALS

A. Format: Refer to Format of Operation and Maintenance Data for requirements.

B. Separate each warranty or bond with index tab sheets keyed to Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.15 WARRANTIES - PREPARATION OF SUBMITTALS

A. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item or Work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until date of [Certified Notice of Completion] [Certified Substantial Completion] is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

1.16 WARRANTIES - TIME OF SUBMITTALS

A. For equipment or component parts of equipment put into service during construction with Owner's permission submit documents within ten days after acceptance.

B. Make other submittals within ten days after date of [Certified Notice of Completion] [Certified Substantial Completion], prior to final Application for Payment.

C. For items of Work when acceptance is delayed beyond date of Notice of Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty period.

1.17 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 location as directed by Owner.

1.18 INSTRUCTIONS TO OWNER'S PERSONNEL

A. Instruct Owner's personnel in proper operation and maintenance of all systems, equipment and similar items which were provided as part of Work. Provide maintenance and inspection schedules that conform to manufacturer's recommendations.

B. Contractor shall provide schedule to Owner for approval for each of instruction periods required.

C. Instruction sessions will be held in Owner designated area on project site and at Owner's convenience. [Amount of time required for each session shall be as specified in individual sections.]

D. Prepare and submit to Architect a sign-in sheet with subject, date and time, signed by all participants for each session.

E. Instructors shall be qualified by product manufacturer in subject matter presented at each session.
   1. Submit names of instructors and qualifications to Architect and Owner for approval, 30 days prior to each scheduled session.
   2. Substitution of instructors will not be permitted without prior approval of Architect or Owner.

PART 2 - PRODUCTS

2.01 MATERIALS - CUTTING AND PATCHING

A. Primary Products: Those required for original installation.

2.02 PRODUCTS FOR PATCHING AND EXTENDING WORK

A. New Materials: As specified in product sections; match existing products and Work for patching and extending Work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing Work as standard.

2.03 CLEANING MATERIALS AND EQUIPMENT

A. Provide required personnel, equipment and materials needed to maintain specified standard of cleanliness.

2.04 COMPATIBILITY

A. Use cleaning materials and equipment that are compatible with surfaces being cleaned, as recommended by manufacturer of material to be cleaned.

PART 3 - EXECUTION

3.01 EXAMINATION - CUTTING AND PATCHING

A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching. Confirm status and current warranties and guarantees.

B. Indicate proposed routing of utilities in Coordinated Drawings and submit to Architect. Do not commence coring cutting operations prior to approval of Coordinated Drawings.

C. After uncovering existing Work, inspect conditions affecting performance of Work.
   1. Prior to cutting, boring or drilling through new or existing structural members or elements including reinforcing bars not specifically detailed, Contractor shall prepare detailed drawings for review and approval by Architect, Structural Engineer of Record and DSA Field Engineer. Approval by DSA is required prior to commencement of Work. Agency approvals will be obtained by Architect not Contractor.

D. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION - CUTTING AND PATCHING

A. Provide temporary support to ensure structural integrity of Work. Provide devices and methods to protect other portions of Project from damage.

B. Provide protection from elements for areas that may be exposed by uncovering Work.

C. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching to complete Work.

B. Fit products together, to integrate with other Work.

C. Uncover Work to install ill-timed Work.

D. Remove and replace defective non-conforming Work.

E. Provide openings in Work for penetration of mechanical and electrical Work.

3.04 PERFORMANCE - CUTTING AND PATCHING

A. Execute Work by methods to avoid damage to other Work and which will provide appropriate surfaces to receive patching and finish.

B. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval. Torches or other flame cutting equipment shall not be used to cut metal studs without prior approval of the Architect.

C. Restore Work with new products in accordance with requirements of Contract Documents.

D. Fit Work airtight to pipes, sleeves, ducts, conduits and other penetrations through surfaces.

E. At penetrations of fire-rated walls, partitions, ceiling or floor construction, completely seal voids with UL-approved fire-rated devices [or material in accordance with Section 07 84 00,] to full thickness of penetrated element.

F. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

G. Extend patching to point where patching is not evident unless directed otherwise by Architect.

3.05 SLEEVES AND HANGERS

A. Provide conduit, outlets, piping sleeves, boxes, inserts or other materials or equipment necessary to be built into Work. Promptly furnish same and set such sleeves or other materials as construction program required.

B. In event delays occur in delivery of sleeves or other materials, arrange to have boxes or other forms set at locations where piping or other material is to pass through or into slabs or other Work.

C. Upon subsequent installation of sleeves or other material, install fill materials as required. Necessary expenditures incurred for boxing out or filling shall be without extra cost to Owner.

3.06 PROGRESS CLEANING

A. General:
   1. Comply with all requirements of Owner's Storm Water Pollution Prevention Plan, Section 01 57 23.
   2. Retain stored items in orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing required protection of materials.
   3. Do not allow accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
   4. At least twice each month, and more often if necessary, remove scrap, debris, and waste material from jobsite.
   5. Provide adequate storage for items waiting removal from jobsite, observing requirements for fire protection and protection of ecology.

B. Site:

1. Daily, and more often if necessary, inspect site and pick up all scrap, debris, and waste material. Remove items to place designated for their storage. Combustible waste shall be removed from site. Flammable waste shall be kept in sealed metal containers until removed from site.
2. Weekly, and more often if necessary, inspect, arrangements of materials stored on site, re-stack, tidy, or otherwise service arrangements to meet requirements specified above.
3. Maintain site in neat and orderly condition.

C. Structures:
1. Weekly, and more often if necessary, inspect structures and pick up scrap, debris, and waste material. Remove items to place designated for their storage.
2. Weekly, and more often if necessary, sweep interior spaces clean.
   a. "Clean", for purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and handheld broom, i.e., "broom-clean".
3. As required preparatory to installation of succeeding materials, clean structures of pertinent portions thereof to degree of cleanliness recommended by manufacturer of succeeding material, using equipment and materials required to achieve required cleanliness.
4. Clean substrate; remove dirt, oil, grease, construction markings, and foreign matter that could adversely affect surface finish appearance or performance.
5. Following installation of finish floor materials, clean finish floor daily, and more often if necessary, and while Work is being performed in space in which finish materials have been installed.
   a. "Clean", for purpose of this subparagraph, shall be interpreted as meaning free from foreign materials which, in opinion of Architect, may be injurious to finish floor material, i.e., "vacuum clean".

3.07 FINAL CLEANING

A. Definition: Except as otherwise specifically provided, "clean", for purpose of Article, shall be interpreted as meaning level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials, i.e., "scrub and polish clean".

B. General: Complete following cleaning operations before requesting inspection for certification of [Notice of Completion] [Substantial Completion].
1. Prior to completion of Work, remove from jobsite all tools, surplus materials, equipment, scrap, debris, and waste, conduct final progress cleaning as described above.
2. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   a. Unless otherwise specifically directed by Architect, water and broom clean paved areas on site and public paved areas directly adjacent to site. Remove resultant debris.
3. Rake grounds that are neither planted nor paved to smooth, even-textured surface.

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

C. Structures:
1. Exterior: In areas affected by Work under this Contract, visually inspect exterior surfaces and remove traces of soils, waste material, smudges and other foreign matter. Remove traces of splashed material from adjacent surfaces. If necessary to achieve uniform degree of exterior cleanliness, hose down exterior of structure. In event of stubborn stains not removable with water, Architect may require light sandblasting or other cleaning at no additional cost to Owner.
2. Interior: In areas affected by Work under this Contract, visually inspect interior surfaces and remove traces of soil waste material, smudges, and other foreign matter. Remove traces of splashed materials from adjacent surfaces. Remove paint drippings, spots, stains, and dirt from finished surfaces. Use only cleaning materials and equipment instructed by manufacturer of surface material.
3. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
4. Polished Surfaces: On surfaces requiring routine application of buffed polish, apply polish recommended by manufacturer of material being polished. Glossy surfaces shall be cleaned and shined as intended by manufacturer.
5. Carpet: Use only dry-chemical method of cleaning. Steam cleaning or water based cleaning shall not be used on carpet. Use only dry-chemical materials and methods fully approved by carpet manufacturer, as instructed in manufacturer's published literature.
6. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

D. Mechanical and Electrical Systems:
1. Wipe surfaces of mechanical and electrical equipment, [elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
2. Replace parts subject to unusual operating conditions.
3. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
4. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
5. Clean ducts, blowers, and coils if units were operated without filters during construction.
6. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

E. Timing: Schedule final cleaning acceptable to the Architect to enable Owner to accept completely clean project.

3.08 CLEANING DURING OWNER'S OCCUPANCY

A. Should Owner occupy Work or any portion thereof prior to its completion by Contractor and acceptance by Owner, responsibilities for interim and final cleaning of occupied spaces shall be determined by Architect in accordance with General Conditions of the Contract.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Remove designated building equipment, fixtures, components and utilities to permit installation of new construction.

B. Include Work required to demolish and remove elements of existing construction including roofing assembly and similar elements of existing building construction, all as noted on Drawings or as required to permit installation of new construction. Refer to Cutting and Patching in Section 01 70 00 for differentiation between "Demolition" and "Cutting and Patching".

C. Comply with Title 24, Part 9, California Fire Code, Chapter 33 Fire Safety During Construction and Demolition, during all Phases of project.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials have been or will be removed by Owner before start of the Work.
   2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner per the General Conditions. Owner will remove hazardous materials under a separate contract.
      a. In the case of asbestos, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Re-assign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. CBC - 2019 California Building Code
   1. CBC Chapter 19A, Concrete.
   2. CBC Chapter 33, Safeguards During Construction.

C. CCR - California Code of Regulations.
   1. CCR-8.4 - Title 8, Subchapter 4, Construction Safety Orders.

D. CFC - 2019 California Fire Code.
   1. CFC Chapter 5, Fire Service Features.
   2. CFC Chapter 7, Fire-Resistance-Rated Construction.
   3. CFC Chapter 9, Fire Protection Systems.
   4. CFC Chapter 33, Fire Safety During Construction and Demolition.

E. ICRI - International Concrete Repair Institute.

F. NFPA - National Fire Protection Association.
   1. NFPA 241- Safeguarding Construction, Alteration and Demolition Operations.

G. Local AQMD - Local Air Quality Management District.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-Demolition Conference: Conduct conference at Project site to comply with below .

B. Contractor shall schedule meeting after Notice of Award to review demolition operations.

C. Attendance Required: Owner, Architect, Contractor, Demolition Subcontractors, Project Inspector.

D. Construction Process:
   1. Contractor shall discuss overview of demolition procedures.
   2. Contractor shall identify items to be selected by Owner for salvage.
   3. Contractor shall review special requirements for equipment, safety, and noise.

E. Architect will record minutes and distribute copies within seven days after meeting to participants and those affected by decisions made.

F. Regulatory Requirements: Secure demolition permit from the Local Air Quality Management District for renovations involving the removal of 100 square feet/linear feet or greater of demolition, per Local AQMD. Notify the Local AQMD at least 10 working days prior to commencement of demolition/renovation.

1.04 SUBMITTALS

A. Project Record Documents accurately record actual locations of capped utilities.

B. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

1.05 EXISTING CONDITIONS

A. Before beginning Work, investigate and verify existence and location of mechanical, drainage, and electrical systems and other construction affecting Work, including underground utilities.
   1. Before construction, survey and record points of connection of utility services.
   2. Locate invert elevation at points of connection to existing sanitary - and storm drain, water-service piping, and underground electrical services.
   3. Employ a utility service locator company to locate underground utilities.
   4. Verify Owner’s Record Drawings.
   5. Furnish survey of existing utilities.

PART 2 - PRODUCTS

2.01 NOT USED.

PART 3 - EXECUTION

3.01 PREPARATION

A. Disconnect, remove and cap designated utility services within demolition areas. Notify Owner 48 hours in advance of any utility shut down.

B. Prior to commencement of demolition operations, notify Underground Service Alert of Northern California (800) 642-2444, Monday through Friday, 7:00 A.M. to 5:00 P.M.

C. Protection:
   1. Protect existing items that are not indicated to be altered.
   2. Adequately protect staff and public from harm and accident during demolition operations by the erection of proper barricades, signs, lighting, guard rails or other safety precautions. Conform to Title 8, Subchapter 4, CCR and NFPA 241.
   3. Protective Devices: Install substantial enclosures, weatherproof and dust-proof shields, protective covers, screens and similar devices. Erect and move when necessary to permit use of existing rooms, areas or facilities. Remove entirely when their use is no longer essential. Patch or repair all areas where devices have been removed.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.02 TEMPORARY MEASURES - LIFE SAFETY

A. Emergency Exits: No enclosure, shield or protective covering shall interfere with use of emergency exits in existing facilities at any time. Rated egress systems shall provide temporary rated egress.

B. Maintain fully charged certified compliant fire extinguishers and water hoses readily available during demolition operations, per Section 906 CBC. Test electrical conductors for disconnection prior to removing.

C. Provide temporary, but equivalent, fire alarm, detection or suppression systems when any system is impaired by Work of this Section. Temporary systems shall be inspected and tested monthly or at other more frequent intervals as required by Owner.
   1. Impairment of fire protection systems, Section 3308.6: Impairments to any fire protection system shall be in accordance with Section 901.
   2. Systems out of Service: Per requirement of Section 901.7 through 901.7.6, California Fire Code.

D. Maintain free and unobstructed access to emergency services per Title 19, CFC 503.1; 503.1.1, 503.4; and Appendix D, CFC Chapter 33 Sections 3310.1; 3312.1 and when required by Owner.

E. Post NO SMOKING signs in English and Spanish, in number and location as approved by Architect.

F. Reduce flammable and combustible fire load to minimum by daily removal of debris.

G. Instruct construction personnel in fire safety and fire drill policies appropriate for areas where demolition operations occur.

H. Deployment, disposition, administration and implementation of any and all safety measures shall be sole responsibility of Contractor.

3.03 EXECUTION

A. Demolish in orderly and careful manner. Maintain protected egress and access at all times.

B. Except where noted otherwise, immediately remove demolished materials from site and dispose legally. Do not utilize Owner's disposal system.

C. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect until re-installation.

D. Do not burn or bury materials on site.

E. Upon completion of Work, leave areas of Work in clean condition.

3.04 SELECTIVE DEMOLITION, REPAIR AND ALTERATIONS WORK

A. New and existing Work that is cut into, altered, damaged, relocated or reinstalled shall be restored to original conditions. Workmanship and materials to conform to applicable provisions of other applicable Sections of Specifications.

B. Cutting Equipment: Jack-hammers and vibratory cutting equipment may be utilized under following conditions:
   1. Approval by Owner.
   2. Time of day and duration of Work on each given day shall be coordinated with Project Inspector and Owner. Minimum of 24 hours advance notice required.
   3. Compressors shall be well muffled.
   4. Every consideration shall be exercised toward comfort of staff and public. Excessive noise or vibrations will constitute just cause for immediate stoppage of Work.

C. Cutting:
   1. Conform to Provisions of Division 01, General Requirements.
   2. Concrete: Cut with saws or other approved method, but do not overcut openings. Reinforcing bars, except where bonded into new concrete, shall be cut off and ends painted with bituminous paint before being enclosed.

3. Structural Members: Cut only when authorized by Architect and approved by Structural engineer of Record, and DSA. Agency approvals shall be obtained by Architect, not by Contractor.
4. Slab-on-grade concrete cutting: saw cut areas indicated, remove aggregate course and excavate subgrade for utility trenches required for depths, and for other non-utility areas as indicated.
    a. Bedding materials for utility trenches: sand consisting of natural or manufactured granular material conforming to Subsection 200-1.5.5, SSPWC, must achieve compaction of a minimum 90%.
    b. Backfill, stockpiled fill: Granular, free of debris, no gravel larger than 3 inches in any dimension, non-expansive, approved by the Architect prior to placement on the site. Install clean backfill and re-compact 6" lifts to 90% per ASTM D1557.
    c. Install reinforcing steel, match existing sizes and spacing, minimum #3 deformed bars spaced 18" oc. Dowel in place by drilling 12" inches into existing concrete and epoxy in place.
    d. Underslab Vapor Barrier: ASTM E 1745, Class A, 15 mils thick, Permeance as tested before and after mandatory conditioning (ASTM E 1745 Section 7.1 and sub-paragraphs 7.1.1 - 7.1.5): less than 0.01 grains/(ft²/hr/inHg).
    e. Install and finish Concrete, minimum 4000 psi compressive strength. Finish: to match existing surface.

D. Removal of Existing Floor Finishes:
1. Remove existing floor covering materials in areas indicated.
2. Sandblast concrete floor surfaces (or submit alternate method to Architect for approval) to remove remaining adhesive, mortar, paint and similar materials which will affect bond of new floor coverings. International Concrete Repair Institute, ICRI Concrete Surface Profile CSP #3 (light shot blast).
3. Patch voids with non-shrink grout.
4. Grind high spots and fill low spots to provide an even surfaced substrate for specified new floor covering materials. Leveling materials shall be compatible with mortars and adhesives required to install finish floors. Floors shall not vary more than 1/4 inch in 10 feet as determined with straightedge.

E. Modular Materials:
1. Resilient tile (VCT), ceramic tile, quarry tile, or similar materials: Remove to joint line without leaving damaged or defective units where joining new construction. After flooring removal, clean substrates to remove setting materials and adhesives.

F. Patching, Repairing and Finishing:
1. Concrete: Edges of existing concrete shall be kept damp for 24 hours and scrubbed with Neat Portland Cement grout just before new concrete is placed. In lieu thereof, an approved epoxy concrete adhesive may be used. Finish shall match existing adjoining Work.
2. Unless otherwise approved concrete shall match strength of existing concrete or be minimum 3,000 psi concrete for patching slabs on grade. Strength of concrete for patching structural members or deck fill shall be determined by Architect. Where cut edges are to remain exposed, finish edges with cement mortar at least 3/4 inch thick, applied over epoxy adhesive and finished to match adjoining surfaces.

3. Concrete mix for patching shall comply with ACI 318.
4. Plaster: Dampen edges of existing plaster. Plaster patching shall be of type, thickness and finish to match existing Work.
5. At Removed Flooring Materials: trowel with patching compound, cement based at all areas, leave level, smooth ready to receive new flooring finish materials. At contractor's option install cement-base self-leveling underlayment at no cost to the Owner.
6. At removed casework and equipment: repair and patch surfaces with like materials and to match adjacent surfaces. Leave surfaces in acceptable condition as determined by the Architect to received new finishes.

G. Asphalt Paving: remove AC paving where indicated in drawings and disposed in legal dumpsites, crushing operations on site and re-use of pulverized AC not permitted.

H. Remove AC striping, lettering, and markings by wet sandblasting machine with sufficient sand, water, and air capacity to completely remove existing striping, [game lines] or markings. Machine shall meet all requirements of air pollution control district having jurisdiction. Conform to Section 310-5.6.3 Standard Specifications for Public Works Construction.

I. Removal of concrete flatwork: remove concrete paving (panel) to the nearest expansion joint or contraction joint and provide matching concrete surface to abut to new work at same finish levels unless noted otherwise.

J. Painting: Areas to be repainted or patched shall be prepared and finished as specified , Painting. Where painting of existing surfaces is scheduled, paint manufacturer's standard specification for interior or exterior maintenance painting may be utilized, when approved by Architect for each surface application.

K. Holes required through existing stud wall, concrete or masonry construction to accommodate new electrical conduits and piping and ductwork shall be provided as specified in Division 22, Plumbing; Division 23, Heating Ventilating and Air Conditioning; Division 26, Electrical and Division 27 Communications. Provide proposed routing of utilities as required in Coordinated Drawing, Division 01, General Requirements.

L. Holes required through concrete or masonry Work required for structural purposes shall be neatly drilled as required to accommodate specific items. Coring shall be performed with approval of Architect and in accordance with details on Drawings.
1. Approval of details by DSA is required. Agency approvals shall be obtained by Architect, not by Contractor.

M. Work shall be fully coordinated to ensure proper sequence, limits, methods and time of performance. Arrange Work so as to impose a minimum of hardship on present operation of facilities.

N. Remove such existing ceilings, floors, walls, finish materials or equipment as required to complete Work. Restore such surfaces to their original condition after Work is completed.

O. Provide adequate ventilation during all operations to prevent accumulation of dust, fumes, vapors or gases.

P. Miscellaneous Removal Items: Items not specifically mentioned shall be removed as indicated on drawings.

Q. Miscellaneous Work: Items not specifically mentioned shall be repaired, patched or finished like new Work or to match existing adjoining surfaces as approved. Surfaces damaged shall be restored to original condition.

3.05 SALVAGE AND DISPOSAL

A. Salvage: Offer Owner first right of refusal for the removed materials that may have residual value. Remove items designated by the Owner to be salvaged with care. Clean, wrap or crate for storage and handling, and deliver to Owner as directed.

B. Disposal: Removed material, other than items directed to be salvaged or indicated to be reused, become Contractor's property upon removal, and shall be removed from site. Debris shall be picked up and disposed of, off site, by Contractor promptly and continuously as Work progresses, and not allowed to accumulate. Sprinkle the debris to prevent dust nuisance. Secure and pay for required hauling permits and pay dumping fees and charges. Contractor shall make every reasonable effort to divert debris to recycling or reuse facilities.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rough carpentry.

B. Related Sections:
   1. Section 01 35 42, CALGreen Requirements.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM International:
   1. ASTM D 3498 - Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
   2. ASTM D 4601 - Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
   3. ASTM E 84 - Surface Burning Characteristics of Building Materials.

C. CBC - California Building Code, 2019

D. California Green Building Standards Code, CALGreen - 2019.

E. DOC PS 1 - Department of Commerce Product Standard, U. S. Product Standard for Construction and Industrial Plywood.

F. DOC PS 20 - Department of Commerce Product Standard, American Softwood Lumber Standards.

G. DOC PS 2 - Department of Commerce Product Standard, U. S. Product Standard for Construction, Performance Standard for Wood-Based Structural-Use Panels.

H. ANSI A135.4 - Basic Hardboard.

I. WWPA - Western Lumber Grading Rules 88, Latest Edition, by Western Wood Products Association.

J. HPVA HP-1 - American National Standard Institute, Hardwood Plywood and Veneer Association.

K. APA - The Engineered Wood Association. The Construction Guide.

L. AWPA C1, C2, C3, C9, C27 - American Wood Preservers Association - Manual of Recommended Practice.

M. AWPA C20 - American Wood Preservers Association Standards, Structural Lumber - Fire-Retardant Treatment by Pressure Process.

N. WCLIB - West Coast Lumber Inspection Bureau Standard Grading Rules No. 17.

O. Title 8 - California Code of Regulations, Construction Safety Orders.

P. ICC - ES - International Code Council Evaluation Service, Inc. Legacy Reports.

Q. RIS - Redwood Inspection Service, Standard Specifications for Grades of California Redwood Lumber.

R. Local AQMD - Local Air Quality Management District Regulations.

1.03 SUBMITTALS

A. Product Data: For the following:
   1. Product Data and current ICC Legacy Reports.

B. Material Certificates.

C. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.A.

1.04 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.
   3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.

B. Rough Carpentry Lumber: Visible grade stamp on all products required.

C. Grade Stamp: Association under whose rules it was graded, or official grade mark of other recognized grading agencies using grading rules, equivalent to WWPA or WCLIB.

D. Association performing grading and grade marking of lumber shall be approved by Architect and Division of the State Architect.

E. Nailing guns and nail operators shall be approved in accordance with Title 8 Construction Safety Orders.

1.05 DELIVERY, STORAGE AND HANDLING

A. Do not deliver rough carpentry items until site conditions are adequate to receive the Work. Protect items from weather while in transit.

B. Store lumber and plywood at the site under cover or otherwise protected against exposure to weather, raise above ground and out of contact with damp or wet surfaces. Stack lumber and plywood and provide for air circulation within and around stacks and under temporary covers. For pressure treated lumber and plywood, provide spacers between courses to permit air circulation.

C. Install bracing as required. Make proper provision to take care of stresses resulting from construction loads, whenever piles materials, erection equipment or other loads are carried by frame during its erection.

1.06 FIELD CONDITIONS

A. Cooperate with other trades in coordinating their Work with the Work of this Section. Provide wood grounds, blocking and nailer where indicated or as required for Work of other trades.

PART 2 - PRODUCTS

2.01 ROUGH CARPENTRY MATERIALS

A. Lumber: Graded in accordance with WWPA or WCLIB; maximum moisture content of 19 percent at time of installation. Provide Douglas Fir Larch for structural and framing lumber, surfaced four sides to standards of the grading association unless otherwise indicated on Drawings, use the following grades:
   1. Joists, rafters, beams, lintels, horizontal framing, posts, studs and vertical framing: No. 1 unless otherwise indicated or noted on drawings.
   2. Non-bearing studs and plates, non-structural furring, concealed blocking, stripping and miscellaneous nailers and backing: No. 2 unless noted otherwise in the structural drawings.
   3. Structural Drawings take precedence for lumber grades.
   4. All lumber in contact with concrete shall be pressure treated.

B. Plywood: CBC Section 2303.3 and 2304.6, Douglas Fir 1 Group Species, PS 1, APA Structural I Rated Sheathing. Bond Classification; Exposure 1 plywood grade. Thickness as indicated, span rating sized for spacing.

1. For painted finish for interior and exterior: APA Sanded Plywood Panels, Panel Grade A-C, Group 1, Exterior plywood grade, sanded face, touch sanded back side.
2. Exposure 1 plywood grade: "CDX", Structural I, C-D.

C. Roof Plywood Decking: requiring FM 1-90 Wind and Fire Classification, minimum 1/2" thick. CBC Section 2304.8, Douglas Fir 1 Group Species, PS 1, APA Structural I Rated Sheathing. Bond Classification: Exposure 1, B-C Veneer Grade, sanded 1 side. Thickness as indicated, span rating sized for spacing.

D. Board Roof Decking: 2 x 6 Douglass Fir, kiln dry, #1 Grade Lumber, Tongue and Groove, surfaced one side.

E. Preservative (Pressure) Treated Lumber: Section 2303.1.9 Conform to AWPA Manual of Recommended Practice, kiln dry after treatment. Use preservative complying with AWPA C2 lumber and C9 plywood, latest edition. Products NOT containing arsenic or chromium. Conform to AQMD, Local Regulations.
1. Douglas Fir Larch, used as required by Section 2303.1.9.1, CBC, shall conform to the following:
   a. Lumber shall be WWPA or WCLIB grade stamped.
   b. Lumber shall be No. 1 grade or better unless indicated otherwise on Drawings.

F. Plywood Backing Panels - Backboards:
1. Telephone and Electrical Equipment backboards, fixed equipment, cabinets, grab bars, door stops and plates: DOC PS 1, Exposure 1, APA A-C, sanded, Veneer Grade, fire-retardant treated, in thickness indicated or, if not indicated, not less than 5/8-inch nominal thickness. Installed "A" side out for paint finish.

2.02 ACCESSORIES

A. Nails, Spikes and Staples: Section 2304.10 CBC, Galvanized for exterior applications, high humidity locations and treated wood; plain finish for other interior locations; size and type to suit application. Comply with Table 2304.10.1. Use common nails only.

B. Bolts, Nuts, Washers, Lags, Pins and Screws: Section 2304.10 CBC, sized to suit application, galvanized for exterior locations, high humidity locations and treated wood, plain finish for other interior locations. Full diameter body bolts only per ASME B18.2.1(.2) or B18.2.6 for structural applications.

C. Expansion type for anchorage to concrete.
1. Kwik Bolt TZ2 (KB-TZ2) Concrete Anchor, 3/8- to 3/4-inch diameter, ICC ESR-4266, by Hilti Inc.

D. Stock Framing Connectors: Section 2304.10 CBC types indicated on Drawings, galvanized, with nails fully driven in all holes in each face of connector. Conform to the following.
1. Manufacturers: Simpson Strong Tie Co., Inc., San Leandro, CA, United Steel Products, Montgomery, MN. or equal.

E. Non-Stock Framing Connectors: Conform to details.

F. Nonshrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 24 hours and 8,000 psi in 7 days; of consistency for application and a 30 minute working time. Acceptable Manufacturers: Dayton Superior, Miamisburg, OH; Sonneborn, Shakopee, MN; Novex Systems International, Clifton NJ, or equal.

G. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4-inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

H. Adhesives: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
   1. Adhesives shall comply with Local AQMD and California VOC Regulations.

PART 3 - EXECUTION

3.01 LAYOUT MARKINGS

A. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

3.02 FRAMING, FURRING AND STRIPPING

A. Erect wood framing, furring, stripping and nailing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch in 10 feet, non-cumulative.

B. Construct members of continuous pieces of longest possible lengths.

C. Construct and erect required headers and lintels.

D. Double wall framing members at openings over 100 square inches. Space short members above and below openings in same manner as for walls.

E. Provide double joist headers at joist ends and around openings unless otherwise indicated on Drawings. Bridge joists and rafters to conform CBC Section 2306.1.1 and as noted on plans. For pre-manufactured joists, provide bridging in accordance with manufacturer’s recommendations.

F. Construct walls with studs of size and spacing indicated, 16 inches on center unless otherwise indicated on drawings. Install single sill member at bottom and double plate at top. Stagger upper and lower members of double plate with joints not less that 4 feet o.c. or as indicated on Drawings. Where sill or any wood member contacts concrete or masonry, install preservative-treated lumber.

G. Provide one row of solid blocking not less than 2 inch nominal thickness and same width of stud at ceiling and floor lines and at spacing not to exceed 8 feet on center vertically. Fit snugly and attach with not less than two 16d nails.

H. Install 3 studs at corners.

I. Conform to CBC Section 2308.5.8, where pipes penetrate sills or plates.

J. Cutting and Notching: Conform to CBC Section 2308.5.9.

K. Bored Holes: Conform to CBC Section 2308.5.10.

L. Conform to CBC Section 718 for fire blocks and draft stops. Fire blocks and stops at 10-feet intervals and at ceiling level.

M. Fire-Retardant Wood: Ripping and milling are not permissible. Cross cutting to length, drilling holes, joining cuts and light sanding are permissible. It is not necessary to field treat cut ends to maintain flame spread rating. All cuts on plywood are considered end cuts and is permissible to be cut.

3.03 2 X ROOF DECKING

A. Place floor decking] with end joints staggered. Secure boards over firm bearing. Maintain tight spacing between joints of boards. Place diagonal to framing members of rafters or joists.

B. Maintain surface flatness of maximum 1/8 inch in 10 ft.

C. Fit edges tight and secure with 2-16dx3.5” nails each contact.

3.04 PLYWOOD SHEATHING

A. Thickness as indicated on the Drawings, minimum thickness 1/2 inch.

B. Boundary Nailing: Not less than 3/8 inch from edge, spaced not more than 6 inches on center, unless noted otherwise on Drawings.

C. Blocking: Panel edges shall bear on framing members or solid blocking.

D. Minimum Size Vertical Panel: 16 inches wide.

E. Minimum Size Horizontal Panel: 24 inches wide.

F. Oriented Strand Board not permitted for shear panels unless indicated on structural drawings.

3.05 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Nail to wood framing.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch apart at edges and ends.

3.06 FOUNDATION FRAMING, PLATES, SILLS AND SLEEPERS

A. Preservative treated wood required. Set wood sills on a bead of continuous butyl sealant on both sides of sill.

B. Under-Floor Clearance for Joist: 18 inches minimum.

C. Under-Floor Clearance for Girders: 12 inches minimum.

D. End Clearance for Lumber Entering Concrete: 1/2 inch minimum.

3.07 HORIZONTAL FRAMING

A. Bearing: 1-1/2-inch minimum on wood or metal, 3 inches on masonry. Lay framing members with crown up. Members with knots at bottom not permitted.

B. Lateral Support: Use solid blocking, cross bridging or other approved means.

C. Lap joists a minimum of 3 inches when framed from opposite sides of a beam. Do not run joists continuous beyond one span unless indicated otherwise on Drawings.

D. Openings: Double joists required for trimmer and headers for openings 4 ft. or larger unless indicated otherwise on Drawings.

E. Provide ties, purlins and blocking in conformance with CBC Sections 2308.8.5.

F. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

END OF SECTION

SECTION 07 01 51

BUILT-UP MEMBRANE ROOFING REPAIR

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Repairing and patching of Built-up roofing membrane to match existing roof system.

B. Field verification
   1. Verify type of existing roof.
   2. Verify extent of the Work.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. Repair Manual for Low-Slope Membrane Roof Systems. Joint publication by the National Roofing Contractors Association (NRCA), SPRI (Single Ply Roofing Institute) and the Asphalt Roofing Manufacturers Association (ARMA).

1.03 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Base flashings and built-up terminations.
   2. Tapered insulation, including slopes.
   3. Crickets, saddles, and tapered edge strips, including slopes.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples
   1. Roofing materials, including base sheet, ply sheet, cap sheet, and flashing sheet, of color required.
   2. Roof insulation.
   3. 3 lb (1.5 kg) of aggregate surfacing material in gradation and color required.
   4. Walkway pads.
   5. Insulation fasteners of each type, length, and finish.

D. Certificates: As indicated under QUALITY ASSURANCE

E. Test and Evaluation Reports
   1. Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of built-up roofing.
   2. Evaluation Reports: For components of roofing, from the ICC-ES.

F. Manufacturer's Installation Instructions

G. Qualification Statements: For manufacturer and installer

1.04 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer
      a. If existing roof is under warranty: Manufacturer of materials for alterations shall be same manufacturer as existing roofing, or approved in writing by manufacturer of existing roofing.;
      b. If existing roof is not under warranty: Company regularly and continuously engaged in the manufacturing of required products for not less than ten (10) years.
   2. Installer: Company approved in writing by manufacturer of materials for roofing alteration and, if existing roof is under warranty, by manufacturer of existing roofing.

B. Certifications: Contractor shall consult with Owner's Representative to ascertain whether existing roof is under warranty, and shall obtain Certifications as follows:
   1. If existing roofing is under warranty: Certification from manufacturer of existing roofing that it has reviewed all proposed procedures, materials, shop drawings details, and other relevant information, and will accept the alterations and repair under its existing warranty.
   2. If existing roofing is not under warranty: Certification from Owner's Representative that Owner's records have been consulted and it has been determined that the roof is not under warranty.

C. Work of this Section shall conform to manufacturer's instructions and California Building Code, Chapter 15.

D. All materials shall be provided by single manufacturer, except as specified herein.

E. All roofing materials shall bear U.L. Labels.

F. Regulatory Requirements
   1. Conform to U.L. Building Materials Directory for roof assembly fire hazard requirements.
   2. Fire Hazard Classification: UL 790, minimum Class A for E Occupancy in accordance with Table 1505.1
   3. Conform to AQMD, local regulations for maximum VOC limits.

G. Pre-installation Conference
   1. Convene a pre-installation conference 2 weeks prior to commencing Work of this Section.
   2. Review installation procedures and coordination required with related work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

C. Stand roll materials on end.

D. Store materials so as not to overstress structure.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing membrane during inclement weather.

B. Do not apply roofing membrane to damp deck surface.

1.07 WARRANTY

A. Notwithstanding the provisions of this Section, existing roofing under guarantee shall be repaired with a roofing system compatible with the system under guarantee, and acceptable to the Guarantor.

1.08 COORDINATION

A. Coordinate Work with work of other sections.

B. Coordinate work of installing associated metal flashings as Work of this Section proceeds.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Manufacturer / Product: The roof system specified in this section is based upon products of Tremco, Inc. or Equal.

2.02 MATERIALS AS APPLICABLE TO MATCH EXISTING SYSTEM

A. Asphalt - ASTM D312, Types II, III or IV.
   1. Type II - Slopes up to 1/2 inch per foot.
   2. Type III - Slopes between 1/2 inch and 3 inches per foot
   3. Type IV - Slopes between 3 inches and 6 inches per foot.

B. Asphalt Glass Fiber Base Sheet - ASTM D4601,Type II.

C. Asphalt Glass Fiber Ply Premier Sheet - ASTM D2178, Type VI, weighing minimum of 7 pounds nper square. Thermglass Type VI or equal.

D. Adhesive - ASTM D4479 Type I Cold Application Adhesive or ASTM D3019, Type III.

E. Modified Bitumen Base Sheet: ASTM D4601, Type II, 25 - 28 lbs. per sq. minimum. Asphalt Glass Fiber base sheet: Composite Ply HT or equal.

F. Modified Bitumen Cap Ply: Styrene Butadiene Styrene (SBS) modified bitumen mineral surfaced cap sheet: ASTM D 5147, glass fiber reinforced, SBS-modified asphalt sheet, Powerply Standard FR or equal.

G. Asphalt Roof Cement, Asbestos-Free - ASTM D4586, Type II, Class I. ELS mastic or equal.

H. Asphalt Primer - ASTM D 41. Tremprime WB or equal.

I. Perlite Cant Strip - ASTM C209, 4 by 4 inches.

J. Roofing Nails: Annular or Spiral Shank, Square head with 1-inch diameter cap.

K. Fire-Retardant Nailers: Chemically treated and pressure impregnated, as defined in Section 202 and 2303.2, California Building Code maximum flame spread of 25, in accordance with ASTM E84. Lumber shall be grade stamped by an approved agency at factory, and shall bear identification indicating fire performance rating thereof. Lumber: AWPA C20.

L. Sealants: as specified in Section 07 92 00.

M. Rosin-Sized sheathing paper: Sealtight Red Rosin Paper by W.R. Meadows

N. Traffic Pads: 5/16 inches thick, 32 by 32 inches. Preformed skid-resistant, modified asphalt panels consisting of reinforcement and fillers, ceramic granules.

O. Loose Roofing Granules: ASTM D451 by 3M Corporation or equal and recommended by the roofing manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify that deck is supported and secured.

C. Verify that deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valleys or eaves.

D. Advise Architect of any corrections required before proceeding with the Work.

E. Other construction adjoining or affecting Work of this Section shall be examined before Work is started.

F. Beginning of installation means installer accepts existing condition affecting the Work.

3.02 ALTERATION, PATCHING AND REPAIRS

A. Where work exposes damaged surfaces, repair and finish, or remove damaged materials, and provide new, acceptable, matching materials, to make continuous areas and surfaces uniform.

B. Repair roof in according to repair practices in the Repair Manual for Low-Slope Membrane Roof Systems.

C. Perform new work to comply with applicable requirements of Specifications.

D. Notwithstanding provisions of this Section, existing roofing under guarantee shall be repaired with roofing system compatible with system under guarantee, and acceptable to Guarantor.

3.03 PROTECTION

A. Protect building surfaces against damage from roofing work.

3.04 INSULATION APPLICATION

A. Install insulation boards in accordance with approved shop drawings and following applicable NRCA Specification.

3.05 MEMBRANE APPLICATION - Basis of Design

A. Comply with requirements of NRCA - Roofing and Water Proofing Manual - Fifth Edition specifications for following existing built-up roofing membrane systems. Roofing system to match existing. Minimum ply requirements:
   1. Type 1 - for Nailable Decks. 1 base sheet 2 glass fiber plies with mineral surfaced SBS Modified Cap Sheet.
   2. Type 2 - for Rigid Insulation above structural deck. 3 glass fiber plies with mineral surfaced SBS Modified Cap Sheet.

B. Rosin-sized Sheathing Paper: at wood deck without rigid insulation, apply one ply of sheathing paper, nailed down, lapped 2 inches on all sides.

C. Base Ply: Apply one 18-inch width base ply at low edge of perimeter. Apply following plies in full widths, lapping each ply 2 inches.
   1. Insulated Decks: per NRCA and FM requirements.
   2. Wood Substrate: Nail laps at 9 inches centers. Down the longitudinal center of each ply install two rows of nails. Rows shall be 11 inches apart, with nailing at 15 inches centers for required nailing coverage of 1-1/3 square feet per fastener.

D. Inner Plies:
   1. Inner Plies: Mop each ply firmly and uniformly with hot asphalt as recommended by manufacturer for each ply system specified.

E. Set each ply firmly and uniformly into hot asphalt mopped on at a nominal rate of 25 pounds per square each.

F. Set plies into asphalt at EVT temperature.

G. Cap Sheet: Install modified bituminous cap sheet according to roofing manufacturer's written instructions. Do not apply cap sheet when wind chill factor is less than 55 degrees F.
   1. Provide accurate, clearly visible thermometers at kettles and at shaded jobsite location.

H. Install base flashing in accordance with roofing manufacturer's instructions, with parapet sheathing in accordance with Section 06 10 53 [06 10 00] for non-rated buildings and exterior fire-resistive gypsum board panels per Section 09 29 00 for rated buildings.

I. Apply in conformance with applicable portions of California Building Code and in conformance with roofing manufacturer's printed application specifications for indicated conditions. However, where specifications of this section exceed code or manufacturer's requirements, the specifications herein shall apply.

J. Cut-Offs: At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and insulation. Provide temporary covering of two (2) plies set in full mopping of bitumen with joints and edges sealed.

3.06 FLASHINGS AND ACCESSORIES

A. As required to match existing system.

3.07 TEST CUTS IF APPLICABLE

A. Perform test cuts only when requested by the Architect.

B. Test Cuts: No extra cost to the Owner. Owner will pay for testing samples as specified in Division 01, Quality Requirements.

C. Cut samples 4 inches by 44 inches at right angles to plies, in areas indicated by Architect for each 2,000 square feet of roof area, or part thereof. One cut shall be taken per building. Test cuts shall be immediately weighed and visually inspected at jobsite by Inspector and then removed for delivery to testing laboratory by Contractor.

D. Coat area from which test cut has been taken evenly, bottom and sides with plastic roof cement. Cut roofing plies to fit and set in alternate plies and plastic cement to fill cut-out flush with surrounding roofing.

E. Apply same number of plies and types of roofing materials as used in roofing specification over repaired cut-out area. Extend first ply 4 inch beyond the cut-out on all sides. Extend each succeeding ply 4 inch beyond the underlying ply, except that final ply shall be full width of roll, centered over samples. Each ply shall be mopped solidly to underlying plies.

3.08 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01 and inspection shall be performed full time by roofing inspection service. Roofing inspector shall oversee but not limited to all base, plies, flashings and surfacing to verify compliance to specifications. Roofing inspection services shall be contracted by the General Contractor and costs included in the General Contractor's bid.

B. Prepare daily reports confirming installation procedures and materials in conformance with the requirements of the Contract Documents. Submit to Architect for review.

C. Correct identified defects or irregularities.

3.09 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by asphalt or any other source of soiling caused by Work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.10 PROTECTION

A. Where traffic must continue over finished roof installation, protect surfaces.

END OF SECTION

SECTION 07 01 52

ROOFING MEMBRANE PENETRATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Coordination of roof and waterproofing membrane penetrations with affected trades.

B. Establishment of criteria for penetrating roof and waterproofing membranes either before or after installation of membranes when penetrations are required by the Work of other Sections.

C. Related Sections:
   1. Division 23, Heating Ventilation and Air Conditioning.
   2. Division 26, Electrical.
   3. Other Sections of the Specifications requiring penetrations.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. Sheet Metal and Air Conditioning Contractors' National Association, SMACNA, "Architectural Sheet Metal Manual".

1.03 QUALITY ASSURANCE

A. Qualifications: Use only skilled workmen who are thoroughly trained and experienced in the necessary crafts.

B. Pre-installation Conference: Convene pre-installation conference under provisions of Division 01, General Requirements.

1.04 WARRANTY

A. For new Work, meet requirements of roofing and waterproofing warranties specified under applicable Division 07 Sections.

B. For existing work, Contractor shall verify if any warranty is in effect and maintain that warranty for all new penetrations. Written certification from the roofing manufacturer of the existing roofing indicating that the membrane penetrations as installed and sealed meet the or exceed the requirements to maintain the existing roofing warranty.

PART 2 - PRODUCTS

2.01 MATERIALS

A. District Standard for Single Ply roofing is UL Class A rated system by Tremco, Inc. or Equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrates and conditions under which Work of this Section will be performed. Do not proceed until unsatisfactory conditions detrimental to timely and proper completion of the Work have been corrected.

3.02 PREPARATION

A. Protect membranes, flashing and adjoining surfaces from damage.

3.03 INSTALLATION

A. Group or cluster pipe and conduit in common penetrations wherever possible to minimize the number of penetrations through membrane.

B. Permitted clearances, except as specifically detailed:
   1. Between penetrations for single pipes: 20 inches clear.
   2. Between penetration for single pipe and toe of cant strip at curb or parapet: 18 inches clear.
   3. Between toes of cant strips at curbs or parapets: 18 inches clear.
   4. Between penetration and gravel stop perimeter: 24 inches clear.

C. Make penetrations in a manner consistent with membrane and flashing installations as follows:
   1. As detailed and specified is Section 07 62 00, Sheet Metal Flashing and Trim.
   2. Where not detailed or specified meet recommendations of Referenced Standards as follows.
      a. SMACNA Figure 4-13 thru 4-16.
      b. NRCA: BUR/MB-12, 13, and 17,18, 19, 21, 22, 23 Single Ply TP-11, 12, 16, 17, 18, 20, 20B, 20C, 22.
      c. Meet requirements of Section 07 92 00, Joint Sealants for sealants and priming.
   3. Where not addressed by details, Specifications or referenced standards, request direction of Architect.

END OF SECTION

SECTION 07 01 54

SINGLE PLY PVC ROOFING MEMBRANE REPAIR

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Repair of existing Mechanically applied single ply PVC roofing membrane including flashings and all other incidental and accessory items to comprise a roofing system matching existing.

1.02 QUALITY ASSURANCE

A. Qualifications

1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturers original containers, dry, undamaged, seals and labels intact, with control number visible.

B. Store products in weather protected environment, clear of ground and moisture. Do not exceed load bearing capacity of structure. Store rolled goods horizontally. Store liquid products away from sparks, open flames or excessive heat or cold.

1.04 PROJECT SITE CONDITIONS

A. Do not apply roofing membrane during inclement weather, ambient temperatures below 45 degrees F or above 95 degrees F.

B. Do not apply roofing membrane to damp or frozen deck surface.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.05 COORDINATION

A. Coordinate Work with other sections.

B. Coordinate Work with installation of associated metal flashings, as Work of this Section proceeds.

1.06 WARRANTY

A. Provide under Provisions of Division 01.

B. Provide two-year guarantee to maintain roofing, flashings and counterflashings in watertight condition from date of certified completion.

C. Contractor warrants that he has reviewed entire set of construction documents and all details pertaining to roofing and are acceptable to Contractor and Installer of roofing products to provide continue guarantees. Contractor agrees to change or add to requirements of contract documents as necessary to comply with requirements of roof manufacturer of roofing products at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 District Standard for Single Ply roofing is UL Class A rated system by Tremco, Inc. or Equal.

PART 3 - EXECUTION

3.01 GENERAL

A. When installing PVC Mechanically Fastened Roofing Membrane in cooler weather liquids such as solvents, sealants, shall be stored at warmer temperatures 50°F or more but not exceeding 80°F until prior to use.

3.02 EXAMINATION

A. Verify existing conditions.

B. Verify condition of deck and is supported and secure.

C. Verify roofing is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valleys or eaves.

D. Confirm dry deck by moisture meter with percent moisture maximum as acceptable to the material manufacturer.

E. Verify condition of roof openings, curbs, pipes, sleeves, ducts and vents through roof and are solidly set.

3.03 PATCHING AND REPAIRS

A. Where work exposes damaged surfaces, repair and finish to match existing, remove damaged materials, and provide new, acceptable, matching materials, to make continuous areas and surfaces uniform. Conform to manufacture's installation details to continue warranty period.

B. Notwithstanding provisions of this Section, existing roofing under guarantee shall be repaired with a roofing system compatible with system under guarantee, and acceptable to Guarantor.

3.04 INSTALLATION OF INSULATION

A. Install according to insulation manufacturer's recommended procedures.
   1. Secure roof insulation with specified fasteners in pattern to achieve Class FM 1-90.

B. Neatly cut to fit around penetrations and projections.

C. Do not install more insulation board than can be covered with roof membrane by the end of the day or the onset of inclement weather.
   1. Minimum 2 layers of insulation or in thickness to match existing, installed staggered with approved fasteners.

D. Mechanical Attachment:
   1. Insulation board shall be mechanically fastened to the deck with approved fasteners and plates at rate according to the insulation manufacturer's, FM's and manufacturers recommendations for fastening rates and patterns. The quantity and locations of the fasteners and plates shall also cause the boards to rest evenly on the roof deck so that there are no significant and avoidable air spaces between the boards and the substrate. Each insulation board shall be installed tightly against the adjacent boards on all sides.
   2. Fasteners are to have minimum penetration into structural deck recommended by the fastener manufacturer and roofing manufacturer.
   3. Use fastener tools with a depth locator and torque-limiting attachment as recommended or supplied by fastener manufacturer to ensure proper installation.
   4. Install minimum 1 fastener for every 4 square feet for single ply installation.
   5. Install in accordance with manufacturer requirements for UL Class A rated system, meeting CBC 1504.1 for wind uplift.

3.05 MEMBRANE APPLICATION

A. Mechanically apply membrane in accordance with manufacturer’s instructions and requirements of the NRCA - Roofing and Water Proofing Manual - 5th Edition, Thermoplastic Roof Specifications. Install in accordance with manufacturer requirements for UL Class A rated system, meeting CBC 1504.1 for wind uplift.

B. Roll out membrane, free from air pockets, wrinkles, or tears. Firmly press sheet into place without stretching.

C. Overlap edges and ends and seal by solvent, minimum 6 inches. Seal permanently waterproof.

D. Shingle joints on sloped substrate in direction of drainage.

E. Extend membrane up and onto vertical surfaces as detailed on drawings.

F. Seal membrane around roof penetrations.

3.06 FLASHINGS AND ACCESSORIES

A. Apply flexible flashings to seal membrane to all vertical and edge elements. Utilize NCRA Roofing and Waterproofing Manual - Fifth Edition, Details TP-1 through TP-23S as applicable for various flashing conditions encountered, unless detailed otherwise on drawings.

B. Install prefabricated roofing control and expansion joints to isolate roof into areas.

C. Coordinate installation of roof drains and related flashings.

D. Seal flashings and flanges of items penetrating membrane.

E. Install heavy duty walkway pads directly to membrane, continuously heat weld perimeter, 1-1/2 inches width welds and as recommended by the manufacturer.

3.07 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01.

B. Correct identified defects or irregularities.

C. Require site attendance of roofing and insulation materials' manufacturer's representative during installation of Work.

D. Water Test: Provide a water tightness test to simulate a rainfall intensity of 1" minimum to a 3" maximum of rain per hour continuously for 24 hours.
   1. Submit sprinkler product data, shop drawings showing coverage of sprinkler heads and methodology before commencement of testing.

3.08 CLEANING

A. In areas where finished surfaces are soiled by Work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

B. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.09 PROTECTION

A. Protect building surfaces against damage from roofing work.

B. Where traffic must continue over finished roof membrane, protect surfaces.

END OF SECTION

SECTION 10 80 00

MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous specialty items applicable to Work and not specified under individual technical sections.

1.02 SUBMITTALS

A. Shop drawings and product data for all components, hardware and accessories under provisions of Division 01, General Requirements. Show construction and fabrications details, procedures, layout and erection diagrams, anchorages and pertinent information for specified specialty item.

B. Samples sufficiently sized to illustrate clearly all sizes, available colors, materials, patterns and finishes.

C. Manufacturer's installation instructions and maintenance recommendations under provisions of Division 01, General Requirements.

1.03 FIELD MEASUREMENTS

A. Verify site conditions. Obtain accurate dimensions of openings, levels, locations and arrangements of embedded and concealed anchorages. Report discrepancies between drawings and field dimensions to Architect before commencing work.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment specialties in accordance with the manufacturer's recommended procedures.

B. Provide electrical and mechanical [irrigation] connections to building systems. Wire internal connections when part of unit’s functionality.

C. Install with wall and floor anchors per manufacturer’s recommendations.

END OF SECTION

SECTION 22 05 10
PLUMBING GENERAL PROVISIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References.
B. Description of Work.
C. Drawings and Specifications.
D. Industry Standards and Codes.
E. Site Examination.
F. Permits, Fees and Utility Connections.
G. Coordination of Work.
H. Progress of Work.
I. Submittals
J. Operation and Maintenance Manuals.
K. Project Record Documents.
L. Warranty.
M. Quality and Care
N. Access Doors.
O. Starting Equipment and Systems.

1.02 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.
D. Section 013300 - Submittals.
E. Section 017000 - Closeout Procedures.

1.03 REFERENCES

A. ANSI - American National Standards Institute.
B. ASTM - American Society for Testing Materials.
C. CEC - California Electric Code.
D. NEC - National Electric Code.
E. NEMA - National Electric Manufacturers' Association.
F. NFPA - National Fire Protection Association.
G. OSHA - Occupational Safety and Health Act.
H. UL - Underwriters' Laboratories.
I. See detailed References that are listed in individual sections.

1.04 DESCRIPTION OF WORK

A. The work included in this division of the specifications consists of furnishing labor, tools, equipment, supplies and materials, unless otherwise specified, and in performing operations necessary for the installation of the complete Plumbing System as required by these specifications or shown on the Drawings, subject to the terms and conditions of the Contract Agreement.

B. The work shall also include the completion of details of plumbing work not mentioned or shown which are necessary for the successful operation of mechanical systems described on the drawings or required by these specifications. Furnish and install any incidental work not shown or specified which is required to provide a complete and operational system.

1.05 DRAWINGS AND SPECIFICATIONS

A. Drawings are schematic and diagrammatic. Drawings indicate the general arrangement of equipment, piping, and other plumbing work. Use judgement and care to install mechanical work to fit the job conditions within the building construction and finishes, and to function properly.

B. The Contractor shall investigate the building conditions affecting the Work and shall arrange his work accordingly providing offsets, fittings, valves and accessories to fit the actual job conditions. The Contractor shall be responsible to field measure and confirm new and existing mechanical systems locations with respect to other architectural, structural, and electrical work, existing and new. Do not scale distances off of the mechanical drawings. Use actual building dimensions.

C. The drawings and specifications are complimentary each to the other. What is required by one shall be as binding as if called for by both.

D. Examine all drawings and specifications prior to bidding the Work. Report any discrepancies to the Engineer.

1.06 INDUSTRY STANDARDS AND CODES

A. The Mechanical Contractor shall comply with the latest provisions of all codes, regulations, laws and ordinances applicable to the work involved. This does not relieve the Contractor from furnishing and installing work shown or specified which may exceed the requirements of such codes, regulations laws and ordinances.

B. All materials, products, devices, fixtures forms or types of construction included in this project shall meet or exceed the published requirements of the publications listed below. These publications form a part of this specification.
   1. California Building Code, 2019.
   2. California Mechanical Code, 2019.
   3. California Plumbing Code, 2019.
   4. California Electrical Code, 2019.
   5. National Fire Protection Association.
   6. California Fire Code, 2019.
   7. California State Fire Marshal.
   8. Occupational Safety and Health Administration, including CAL-OSHA.
   9. California Energy Code, 2019.
   10. California Green Building Standards Code, 2019.
   11. State of California Code of Regulations, Title 24.
   12. Other applicable state laws.

C. Nothing in the Drawings or Specifications shall be construed to permit work that does not conform these codes. When Contract Documents differ from governing codes, furnish and install to the higher standard required at no extra charge. The Contract

Documents are not intended to repeat the code requirements except where necessary for clarity.

D. No material or product installed as a part of the Work shall contain asbestos in any form.

E. Domestic water piping and components shall be provided and installed in accordance with California AB 1953 Legislation (effective January 1, 2010), which limits the allowable lead content in certain domestic water system components.

1.07 SITE EXAMINATION

A. Contractor shall examine the site, verify dimensions and locations with Drawings, check utility connection locations, and familiarize himself with the existing conditions and limitations. No extras will be allowed because of the Contractor's misunderstanding of the amount of work involved or his lack of knowledge of any site condition which may affect his work. Any apparent variance of the drawings or specifications from the existing conditions at the site shall be called to the attention of the Engineer immediately.

1.08 PERMITS, FEES AND UTILITY SERVICES

A. Contractor shall pay for and obtain all permits and service required in the installation of this work.

B. Contractor shall arrange for all required inspections and will secure approvals from authorities having jurisdiction.

1.09 COORDINATION OF WORK

A. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work and that such establishment is the exclusive responsibility of the contractor.

B. The Contractor shall give careful consideration to the work of the General, Electrical and other contractors on the job and shall organize his work so that it will not interfere with the work of other trades. He shall consult the drawings and specifications for work of other trades for correcting information, and the pertinent drawings for details and dimensions.

C. Arrange plumbing work in a neat, well-organized manner with the piping and similar services running parallel and/or perpendicular to primary lines of the building construction. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.

D. Verify the location of all equipment, plumbing devices, etc. and if interference develops, the Owner/Engineer's decision will be final and no additional compensation will be allowed for the moving of misplaced air devices or equipment.

1.10 PROGRESS OF WORK

A. This Contractor shall organize his work so that the progress of the mechanical work will conform to the progress of the other trades, and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from defective or ill timed work performed under this section shall be borne by this Contractor.

1.11 STRUCTURAL DESIGN REQUIREMENTS AND SEISMIC RESTRAINTS

A. Plumbing systems and equipment shall be anchored and seismically braced in accordance with all applicable codes and industry standards.

B. Plumbing systems and equipment shall include, but are not limited to, all piping, water heaters, expansion tanks, air compressors, vacuum pumps, electrical and control panels, conduits and other components.

C. For all non-standard installations not detailed in one of the approved systems, the Contractor shall provide details of supports, anchorages and restraints, including attachments to building structure, with supporting calculations all stamped and signed by a licensed professional structural engineer registered in the state in which the Work is performed.

1.12 SUBMITTALS

A. See Section 013300 - Submittals, for additional submittal procedures.

B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Shop Drawing Submittals: Prepared specifically for this Project.

D. Organize submittals in sequence according to Specification Section. Submit in bound document with tabs identifying each Specification Section. Provide a Table of Contents identifying the Specifications Sections being submitted and the contents within each tabbed section. Prepare Submittals in multiple volumes if required. Provide a complete Submittal package at one time. Do not submit individual Sections piecemeal.

E. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Furnish, upon request, installation instructions for all equipment and materials to Inspector of Record prior to installation.

G. Maintain a copy of the fire penetration installation instructions on site for use by the Inspector of Record.

1.13 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

B. LP Consulting Engineers, Inc. will consider requests for substitutions only within 7 days after date of Agreement.

C. Substitutions may be considered when a product becomes unavailable through no fault of the .

D. Failure by the Contractor to order materials or equipment in a timely manner will not constitute justification for a substitution.

E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

F. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to TRUSD.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse TRUSD and LP Consulting Engineers, Inc. for review or redesign services associated with reapproval by authorities including obtaining reapproval by authorities.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. If excessive review, as judged by the Engineer, is required caused by complicated, numerous or repetitive requests, Contractor shall reimburse Engineer and its Consultants for such review at their standard billing rates.

I. Substitution Submittal Procedure:
   1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The LP Consulting Engineers, Inc. will notify in writing of decision to accept or reject request.
   4. Present each substitution individually. If a proposed substitute in not found to be acceptable, then the specified item shall be supplied.

1.14 OPERATION AND MAINTENANCE MANUALS

A. See Section 01700 Closeout Submittals for Operation and Maintenance Manual requirements.

B. Provide operating and maintenance instructions, diagrams and parts lists for all components of all mechanical systems and each piece of equipment furnished under these specifications.

C. Operating and maintenance instructions shall be furnished for the following equipment and systems:
   1. Plumbing Systems.
   2. Medical Gas Equipment, Piping and Alarm Systems.
   3. Piping Systems.
   4. Temperature Controls Systems.
   5. Testing, Adjusting, and Balancing Reports.

D. Provide manufacturer's model number, design data, capacities, etc. for each piece of plumbing equipment furnished as a part of the Work.

E. The operating instructions shall include procedures for starting, stopping and emergency manual operation for all equipment and systems.

F. Provide maintenance instructions of each item of individual equipment including applicable maintenance data as recommended by the manufacturer, including frequency of lubrication, lubricants, inspections required, adjustment procedures, belt and pulley sizes, etc.

G. Provide manufacturer's parts bulletins with part numbers for each item of equipment included in the Work. Parts bulletins shall be specific to the equipment provided. Extraneous information that does not apply to the equipment provided shall be eliminated from the literature.

H. Include copies of test reports (startup, check, etc.) and inspections performed for each piece of equipment provided in the Work.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in TRUSD's name and registered with manufacturer.

J. Provide supplier and manufacturer contacts, telephone numbers and addresses in the front portion of the operation and maintenance manual.

1.15 PROJECT RECORD DOCUMENTS

A. See Section 017700 - Closeout Procedures.

B. Provide red-lined drawings accurately showing location of equipment and devices and size and routing of piping. Include notes explaining installed condition for complete understanding.

1.16 QUALITY ASSURANCE

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from LP Consulting Engineers, Inc. before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

1.17 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.18 WARRANTY

A. See Section 01700 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 QUALITY AND CARE

A. All materials shall be new and in perfect condition when installed unless specifically indicated otherwise. Materials shall be tested within the Continental United States by an independent, nationally recognized testing agency and shall be listed in accordance with testing agency requirements. When not otherwise specified, all material shall conform to applicable National Standards (ANSI).

B. All capacities, sizes and efficiency ratings shown on the drawing are minimum. Gas meter and gas pressure reducing valve capacities are maximum allowable.

C. Each category of material or equipment shall be of the same brand or manufacturer throughout the Work wherever possible.

D. The quality of materials and equipment to be provided is defined by the brand names, manufacturers, model and catalog numbers listed on the Drawings and in the Specifications. Contractor shall provide each item listed, of the quality specified, or equal.

E. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

F. Inspect and report concealed damage to carrier within their required time period.

G. Store materials in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect from dirt, water, construction debris, and traffic.

H. Equipment which has been damaged, exposed to weather or is, in the opinion of the Engineer or Owner, otherwise unsuitable because of improper fabrication, storage or installation shall be removed and replaced by this Contractor at his expense.

2.02 ACCESS DOORS

A. Coordinate access door requirements with Section 08305. The more stringent requirements shall govern.

B. Provide access doors where access through floors, walls or ceilings is required to access plumbing equipment and plumbing devices or other systems requiring access for maintenance, test or observation.
   1. Access doors requiring hand access or access for observation only shall be 14"x14" minimum usable opening.
   2. Access doors where entrance of a service person may be required shall be 24"x30" minimum usable opening.

C. Established standard: Milcor of types listed below. Other acceptable manufacturers: Cesco, J.L. Industries, Karp, Larsen's, or equal. Comply with the following:
   1. Form doors and frames of welded, ground smooth steel construction, 14 gauge for doors, 16 gauge for frames. Provide prime coat finish except for stainless steel type.
   2. Concealed hinges to allow 175 degree opening.
   3. Locks: flush, screw driver operated cam lock(s).
   4. Provide anchoring devices suitable for the construction into which the doors are framed.

D. Application (as applicable):
   1. In gypsum drywall walls and ceilings: Type DW.
   2. In ceramic tile walls: Type MS (stainless steel).
   3. In fire rated walls: Type Fire Rated (rating as required for wall or ceiling), self closing, 250 F in 30 min. temperature rating.

PART 3 EXECUTION

3.01 INSTALLATION

A. Access Doors
   1. Coordinate the exact location of access doors to provide proper access to the item concealed. Obtain written approval for access door locations from Architect.
   2. Coordinate installation of access doors with the trades performing the construction assemblies into which the access doors are placed.
   3. Install all access doors neatly and securely, to open and close completely, and to operate freely and without binding. Install rated doors in accordance with their listing requirements.
   4. Test operate all doors and make all adjustments required for satisfactory operation. Replace all damaged materials.
   5. Install in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with the requirements within this section.

B. Test all piping with no leak or loss in pressure in accordance with the requirements within this section.

3.03 GENERAL TESTING REQUIREMENTS FOR MECHANICAL AND PLUMBING SYSTEMS

A. Contractor shall assign a responsible person to be an independent representative to witness testing and to sign as witness of times, pressure and losses of testing media for all hydronic, duct and gas piping testing.
   1. Test all piping as noted below with no leak or loss of pressure. Repair or replace defective piping until tests are accomplished successfully.
   2. Submit to the Engineer for review a log of all tests made which shall include time, temperature, pressure, water makeup and other applicable readings, necessary to indicate the systems have been operated and tested in the manner outlined in the construction documents.
   3. After producing the specified test pressure, disconnect the pressurizing source; do not introduce further pressure for the duration of the test period, repair leaky piping and retest. Repeat the procedure until the entire system is proven tight.

B. Test the following systems with the medium listed to the pressure indicated for the time period listed:
   1. Sanitary Sewer, Drain, Vent Piping: Pressure=10 Ft.Hd. / Medium= Water / Duration=4 Hours.
   2. Domestic Water Piping: Pressure=125 Psig / Medium= Water / Duration=4 Hours.
   3. Condensate drains: Pressure=10 Ft.Hd. / Medium=Water / Duration=4 Hours.
   4. Gas Piping: Pressure=60 Psig / Medium=Air and soap / Duration=8 Hours.

3.04 CUTTING AND PATCHING

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of TRUSD or separate Contractor.

B. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

C. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

E. Restore work with new Products in accordance with requirements of Contract Documents.

F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Code requirements , to full thickness of the penetrated element.

H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.05 PRIMING AND PAINTING

A. Apply primer to all exposed ferrous metals that are not factory primed, factory finished, galvanized, stainless steel or anodized. Exposed black steel piping shall be primed and finish painted, including gas piping outdoors.
   1. Primer shall be as recommended by the paint manufacturer for each specific application.
   2. Acceptable Products include: Fuller O'Brien Blox-Rust Metal All Purpose Primer, equivalent Rust-Oleum product, or equal. See Section 09900 for other acceptable products.

B. Apply two coats of primer to metal surfaces of items to be insulated or jacketed, except piping, or factory primed or finished.

C. Preparation:
   1. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
   2. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; seal stains and marks which cannot be completely removed using Devoe KILSTAIN primers, shellac, or other coating acceptable to paint manufacturer any marks or defects that might bleed through paint finishes.
   3. Remove mildew from impervious surfaces by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow substrate to thoroughly dry.
   4. Galvanized Surfaces:
      a. Remove surface contamination and oils by solvent cleaning in accordance with SSPC-SP 1 and allow to dry.
      b. Apply Devoe MIRROLAC Galvanized Metal Primer in accordance with manufacturer instructions.
   5. Uncoated Steel And Iron Surfaces:
      a. Remove grease, rust, scale, and dust from steel and iron surfaces using solvent in accordance with SSPC-SP 1.
      b. Where heavy coatings of scale or contaminants are evident, hand tool clean in accordance with SSPC-SP 2 or use other approved SSPC SP method as needed.
   6. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate Devoe MIRROLAC metal primer or primer recommended by manufacturer.

D. Application:
   1. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
   2. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
   3. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

E. Finish Painting: See Section 09900.

3.06 STARTING EQUIPMENT AND SYSTEMS/COMMISSIONING

A. Start equipment and systems in accordance with manufacturer's written instructions..

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to TRUSD's designated representative.

D. Description:
   1. Comply with all start up of mechanical and electrical equipment systems as required in the various sections and herein.
   2. Coordinate all testing and startup procedures with all other trades so that all non-plumbing and non-electrical work is completed and operational so that the specified testing can be performed.

E. Preliminary Work:
   1. Prior to the startup, the Contractor shall ensure that the systems are ready to operate, and the following items have been completed and checked including but not limited to:
      a. Proper motor and fan/pump rotation.
      b. Flushing and cleaning of the system.
      c. Wiring
      d. Auxiliary connections
      e. Lubrication.
      f. Venting.
      g. Controls.
      h. Installation of filters and strainers.
      i. Setting of relief and safety valves .
   2. All electrical testing must be completed and test results submitted before equipment startup to avoid power interruptions during mechanical equipment startup and testing.
   3. The Contractor shall submit at least 30 days in advance a schedule listing the date of completion of his work as it will be ready for equipment startup of Electrical/Plumbing equipment. This schedule shall include work on a system by system, floor by floor basis.
   4. Two weeks prior to the startup of any major equipment, the Contractor shall certify in writing that the systems will be complete and ready for startup. Completeness shall not only include physical installation of individual pieces of equipment, but all related elements of other crafts to make all equipment operate as a system.
      a. The startup checklist will cover all related crafts, e.g., controls, electrical, plumbing, and a clean environment for equipment startup.
   5. Equipment of systems should not be started until systems and associated subsystems are completed. Verify that other continuing work could not possibly damage completed systems if they are in operation. Furnish signed off prestartup check sheet.

F. Startup and Commissioning:
   1. System Startup and Operation:
      a. The Contractor shall provide all labor, materials and services necessary for the initial startup and operation of all systems and equipment furnished and installed under this section.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.
B. Angle valves.
C. Ball valves.
D. Butterfly valves.
E. Check valves.
F. Gate valves.
G. Globe valves.
H. Plug valves.

1.02 RELATED REQUIREMENTS

A. Section 08 31 00 - Access Doors and Panels.
B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
C. Section 22 07 19 - Plumbing Piping Insulation.
D. Section 22 10 05 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non-rising stem.
E. OS&Y: Outside screw and yoke.
F. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. SWP: Steam working pressure.
I. TFE: Tetrafluoroethylene.
J. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2017.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
G. ASME B31.9 - Building Services Piping 2020.

H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2021.

I. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2022.

J. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).

K. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings 2015 (Reapproved 2021).

L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.

M. AWWA C606 - Grooved and Shouldered Joints 2015.

N. MSS SP-45 - Drain and Bypass Connections 2020.

O. MSS SP-67 - Butterfly Valves 2017, with Errata.

P. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends 2011.

Q. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends 2018.

R. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service 2010a.

S. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends 2011.

T. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.

U. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends 2011.

V. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

W. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided 2018.

X. NSF 61 - Drinking Water System Components - Health Effects 2021.

Y. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.05 SUBMITTALS

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

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

D. Maintenance Materials: Furnish TRUSD with one wrench for every five plug valves, in each size of square plug valve head.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer:
   1. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, gate or plug.
   2. Throttling: Provide globe, angle, ball, or butterfly.
   3. Swing Check (Pump Outlet):
      a. 2 NPS and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
      b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
      c. 2-1/2 NPS and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

C. Required Valve End Connections for Non-Wafer Types:
   1. Steel Pipe:
      a. 2 NPS and Smaller: Threaded ends.
      b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
      c. Grooved-End Steel Piping: Grooved.
   2. Copper Tube:
      a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
      b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

D. Domestic, Hot and Cold Water Valves:
   1. All sizes:
      a. Bronze and Brass: Provide with solder-joint or threaded ends.
      b. Bronze Angle: Class 125, bronze disc.
      c. Ball: Two piece, full port, brass with brass trim.
      d. Bronze Swing Check: Class 125, bronze disc.
      e. Bronze Gate: Class 125, NRS.

E. Gas Valves:
   1. All sizes:
      a. Bronze: Provide with threaded ends.
      b. Ball: One piece, full port, bronze with bronze trim.
      c. Lubricated Plug: Class 125, regular gland.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
   2. Handwheel: Valves other than quarter-turn types.
   3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
   4. Wrench: Plug valves with square heads.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
   1. Gate Valves: Rising stem.

2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.03 BRONZE, ANGLE VALVES

A. Class 125: CWP Rating: 200 psig.
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

A. Two Piece, Full Port with Brass Trim and Threaded or Soldered Connections:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig, WOG.
4. Body: Forged brass.
5. Seats: PTFE.
6. Ball: Chrome-plated brass.

2.05 BRONZE, BALL VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends: Threaded.

6. Seats: PTFE.
7. Stem: Bronze.
8. Ball: Chrome plated brass.

2.06 BRONZE, LIFT CHECK VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:
1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
2. CWP Rating: 200 psig.
3. Design: Vertical flow.
4. Body: Comply with ASTM B61 or ASTM B62, bronze.
5. Ends: Threaded as indicated.

2.07 BRASS, INLINE CHECK VALVES

A. Class 150: CWP Rating: 300 psig, WOG.

B. Maximum Service Temperature: 250 deg F.

C. Body: Forged brass.

D. Disc: Forged brass.

E. Seal: PTFE, bubble-tight.

F. End-Connections: Threaded.

2.08 BRASS, HORIZONTAL SWING CHECK VALVES

A. Threaded End-Connections:
1. Class 125: CWP Rating: 200 psig, WOG.
2. Body: Forged brass.
3. Disc: Forged brass.
4. Hinge-Pin, Screw, and Cap: Forged brass.

2.09 BRONZE, SWING CHECK VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 CWP Rating; 200 psig (1,380 kPa) WOG:
1. Comply with MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. Body: Bronze, ASTM B62.
4. Ends: Threaded.
5. Disc: Bronze.

2.10 BRONZE, GATE VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. NRS (Non-rising Stem) or OS & Y (Rising Stem):
1. Comply with MSS SP-80, Type I.
2. Class 125: CWP Rating 200 psig.
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded or solder joint joint.

5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.

2.11 LUBRICATED PLUG VALVES

A. Regular Gland with Flanged Ends:
1. Comply with MSS SP-78, Type II.
2. Class 125: CWP Rating: 200 psig.
3. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
4. Pattern: Regular or short.
5. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Install check valves where necessary to maintain direction of flow as follows:
1. Lift Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing 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 A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2014 (Reapproved 2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

I. MFMA-4 - Metal Framing Standards Publication 2004.

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

K. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
   a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
   b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Piping up to 1 inch (27 mm) nominal: 3/8 inch diameter.
   c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
   d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
1. General Construction and Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
   c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
   d. Insulation inserts to consist of calcium silicate insulation surrounded by a 360 degree, PVC jacketing.
2. PVC Jacket:
   a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
   b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   c. Thickness: 60 mil.

E. Pipe Supports:
1. Liquid Temperatures Up To 122 degrees F:
   a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
   b. Support From Below: MSS SP-58 Types 35 through 38.
2. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 Types 35 through 38.

F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
   1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
   2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

G. Riser Clamps:
   1. Provide copper plated clamps for copper tubing support.
   2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

H. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

I. Strut Clamps: Two-piece pipe clamp.

J. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

K. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
   1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
   2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

L. Pipe Alignment Guides: Galvanized steel.
   1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
   2. Pipe Diameter 10 inches and Larger: Roller type.

M. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

N. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
   1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
   4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

O. Pipe Shields for Insulated Piping:
   1. General Construction and Requirements:
      a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
      b. Shields Material: UV-resistant polypropylene with glass fill.
      c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
      d. Minimum Service Temperature: Minus 40 degrees F.
      e. Maximum Service Temperature: 178 degrees F.
      f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

P. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.04 SUBMITTALS

A. See Section 013300 - Submittals, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Pipe Markers: 3/4 inch diameter and higher.

2.02 IDENTIFICATION APPLICATIONS

A. Heat Transfer Equipment: Nameplates.

B. Major Control Components: Nameplates.

C. Piping: Pipe markers.

D. Pumps: Nameplates.

E. Small-sized Equipment: Tags.

F. Tanks: Nameplates.

G. Valves: Tags and ceiling tacks where located above lay-in ceiling.

H. Water Treatment Devices: Nameplates.

2.03 MANUFACTURERS

A. Brady Corp.

B. Seton Identification Products.

2.04 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.
   4. Plastic: Comply with ASTM D709.

2.05 TAGS

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

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

2.06 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Secure to pipe using two (2) bands of adhesive tape with flow arrows supplied by the manufacturer. Install securing bands completly around pipe and overlapped.

C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

D. Identification Scheme, ASME A13.1:
   1. Primary: External Pipe Diameter, Uninsulated or Insulated.
   2. Secondary: Color scheme per fluid service.
      a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

D. Identify domestic hot water heating equipment, including pumps, etc. with plastic nameplates.

E. Identify valves in main and branch piping with tags.

F. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Identify all medium pressure gas piping (over 11" W.C. to 5 PSI pressure) with pressure contained within piping system (for example: "MPG 5 PSI")

END OF SECTION

SECTION 22 10 05
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.

B. Natural gas piping, above grade.

C. Pipe flanges, unions, and couplings.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

B. Section 078446 - Fire-Resistive Joint Systems.

C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

D. Section 22 07 19 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

B. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV 2021.

C. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV 2017.

D. ASME B31.1 - Power Piping 2020.

E. ASME B31.9 - Building Services Piping 2020.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.

G. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2019.

I. ASTM B32 - Standard Specification for Solder Metal 2020.

J. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.

K. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.

L. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.

M. AWWA C651 - Disinfecting Water Mains 2014, with Addendum (2020).

N. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2018.

O. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2018.

P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

Q. MSS SP-67 - Butterfly Valves 2017, with Errata.

R. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

S. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

T. NSF 61 - Drinking Water System Components - Health Effects 2021.

U. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with State of California, standards.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

1.06 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of California plumbing code.

B. Domestic water piping and components shall be provided and installed in accordance with California AB 1953 Legislation (effective January 1, 2010), which limits the allowable lead content in certain domestic water system components.

C. Conform to applicable code for installation of backflow prevention devices.

D. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 DRAIN PIPING, ABOVE GRADE

A. Copper Tube: ASTM B 306, DWV or ASTM B 88 (ASTM B 88M), Type M (C), Drawn (H).
   1. Application: Condensate drains inside building (non-acidic).
   2. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.
   3. Joints: ASTM B32, alloy Sn50 solder.

B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, using one of the following joint types:
   1. Application: Condensate drains outside building (non-acidic).

2. Threaded Joints: ASME B16.3 malleable iron fittings.

C. PVC Pipe: ASTM D2665.
1. Application: Condensate drains (acidic).
2. Fittings: PVC.
3. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Pipe size 2" and smaller: Malleable iron threaded fittings.
2. Pipe size 2-1/2" and larger: Steel butt welded fittings.
3. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
4. Joints: Threaded or welded to ASME B31.1.

2.04 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 2 Inches and Under:
1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 STRAINERS

A. Size 2 inch and Smaller:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 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.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

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

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

J. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.

K. Install water piping to ASME B31.9.

L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

M. Sleeve pipes passing through partitions, walls, and floors.

N. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Provide copper plated hangers and supports for copper piping.
   7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
   8. Support cast iron drainage piping at every joint.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.

B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inch to 1-1/4 inch:
         1) Maximum Hanger Spacing: 6.5 ft.
         2) Hanger Rod Diameter: 3/8 inches.
      b. Pipe Size: 1-1/2 inch to 2 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 3/8 inch.
      c. Pipe Size: 2-1/2 inch to 3 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 1/2 inch.
      d. Pipe Size: 4 inch to 6 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 5/8 inch.

END OF SECTION

SECTION 23 05 10
MECHANICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References.
B. Description of Work.
C. Drawings and Specifications.
D. Industry Standards and Codes.
E. Site Examination.
F. Permits, Fees and Utility Connections.
G. Coordination of Work.
H. Progress of Work.
I. Submittals
J. Operation and Maintenance Manuals.
K. Project Record Documents.
L. Warranty.
M. Quality and Care
N. Access Doors.
O. Starting Equipment and Systems.

1.02 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.
D. Section 013300 - Submittals.
E. Section 017000 - Closeout Procedures.

1.03 REFERENCES

A. ANSI - American National Standards Institute.
B. ASTM - American Society for Testing Materials.
C. CEC - California Electric Code.
D. NEC - National Electric Code.
E. NEMA - National Electric Manufacturers' Association.
F. NFPA - National Fire Protection Association.
G. OSHA - Occupational Safety and Health Act.
H. UL - Underwriters' Laboratories.
I. See detailed References that are listed in individual sections.

1.04 DESCRIPTION OF WORK

A. The work included in this division of the specifications consists of furnishing labor, tools, equipment, supplies and materials, unless otherwise specified, and in performing operations necessary for the installation of the complete Mechanical System as required by these specifications or shown on the Drawings, subject to the terms and conditions of the Contract Agreement.

B. The work shall also include the completion of details of mechanical work not mentioned or shown which are necessary for the successful operation of mechanical systems described on the drawings or required by these specifications. Furnish and install any incidental work not shown or specified which is required to provide a complete and operational system.

1.05 DRAWINGS AND SPECIFICATIONS

A. Drawings are schematic and diagrammatic. Drawings indicate the general arrangement of equipment, piping, ductwork and other mechanical work. Use judgement and care to install mechanical work to fit the job conditions within the building construction and finishes, and to function properly.

B. The Contractor shall investigate the building conditions affecting the Work and shall arrange his work accordingly providing offsets, fittings, valves and accessories to fit the actual job conditions. The Contractor shall be responsible to field measure and confirm new and existing mechanical systems locations with respect to other architectural, structural, and electrical work, existing and new. Do not scale distances off of the mechanical drawings. Use actual building dimensions.

C. The drawings and specifications are complimentary each to the other. What is required by one shall be as binding as if called for by both.

D. Examine all drawings and specifications prior to bidding the Work. Report any discrepancies to the Engineer.

1.06 INDUSTRY STANDARDS AND CODES

A. The Mechanical Contractor shall comply with the latest provisions of all codes, regulations, laws and ordinances applicable to the work involved. This does not relieve the Contractor from furnishing and installing work shown or specified which may exceed the requirements of such codes, regulations laws and ordinances.

B. All materials, products, devices, fixtures forms or types of construction included in this project shall meet or exceed the published requirements of the publications listed below. These publications form a part of this specification.
   1. California Building Code, 2019.
   2. California Mechanical Code, 2019.
   3. California Plumbing Code, 2019.
   4. California Electrical Code, 2019.
   5. National Fire Protection Association.
   6. California Fire Code, 2019.
   7. California State Fire Marshal.
   8. Occupational Safety and Health Administration, including CAL-OSHA.
   9. California Energy Code, 2019.
   10. California Green Building Standards Code, 2019.
   11. State of California Code of Regulations, Title 24.
   12. Other applicable state laws.

C. Nothing in the Drawings or Specifications shall be construed to permit work that does not conform these codes. When Contract Documents differ from governing codes, furnish and install to the higher standard required at no extra charge. The Contract

Documents are not intended to repeat the code requirements except where necessary for clarity.

D. No material or product installed as a part of the Work shall contain asbestos in any form.

1.07 SITE EXAMINATION

A. Contractor shall examine the site, verify dimensions and locations with Drawings, check utility connection locations, and familiarize himself with the existing conditions and limitations. No extras will be allowed because of the Contractor's misunderstanding of the amount of work involved or his lack of knowledge of any site condition which may affect his work. Any apparent variance of the drawings or specifications from the existing conditions at the site shall be called to the attention of the Engineer immediately.

1.08 PERMITS, FEES AND UTILITY SERVICES

A. Contractor shall pay for and obtain all permits and service required in the installation of this work.

B. Contractor shall arrange for all required inspections and will secure approvals from authorities having jurisdiction.

1.09 COORDINATION OF WORK

A. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work and that such establishment is the exclusive responsibility of the contractor.

B. The Contractor shall give careful consideration to the work of the General, Electrical and other contractors on the job and shall organize his work so that it will not interfere with the work of other trades. He shall consult the drawings and specifications for work of other trades for correcting information, and the pertinent drawings for details and dimensions.

C. Arrange mechanical work in a neat, well-organized manner with the piping, conduit, and similar services running parallel and/or perpendicular to primary lines of the building construction. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.

D. Verify the location of all equipment, and devices, etc. and if interference develops, the Owner/Engineer's decision will be final and no additional compensation will be allowed for the moving of misplaced air devices or equipment.

1.10 PROGRESS OF WORK

A. This Contractor shall organize his work so that the progress of the mechanical work will conform to the progress of the other trades, and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from defective or ill timed work performed under this section shall be borne by this Contractor.

1.11 STRUCTURAL DESIGN REQUIREMENTS AND SEISMIC RESTRAINTS

A. Mechanical systems and equipment shall be anchored and seismically braced in accordance with all applicable codes and industry standards.

B. Mechanical systems and equipment shall include, but are not limited to, all piping, heating and ventilating equipment, electrical and control panels, conduits and other components.

C. For all non-standard installations not detailed in one of the approved systems, the Contractor shall provide details of supports, anchorages and restraints, including

attachments to building structure, with supporting calculations all stamped and signed by a licensed professional structural engineer registered in the state in which the Work is performed.

1.12 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for additional submittal procedures.

B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Shop Drawing Submittals: Prepared specifically for this Project.

D. Organize submittals in sequence according to Specification Section. Submit in bound document with tabs identifying each Specification Section. Provide a Table of Contents identifying the Specifications Sections being submitted and the contents within each tabbed section. Prepare Submittals in multiple volumes if required. Provide a complete Submittal package at one time. Do not submit individual Sections piecemeal.

E. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Furnish, upon request, installation instructions for all equipment and materials to Inspector of Record prior to installation.

G. Maintain a copy of the fire and smoke damper installation instructions on site for use by the Inspector of Record.

1.13 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

B. LP Consulting Engineers, Inc. will consider requests for substitutions only within 7 days after date of Agreement.

C. Substitutions may be considered when a product becomes unavailable through no fault of the .

D. Failure by the Contractor to order materials or equipment in a timely manner will not constitute justification for a substitution.

E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

F. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to TRUSD.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse TRUSD and LP Consulting Engineers, Inc. for review or redesign services associated with reapproval by authorities including obtaining reapproval by authorities.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. If excessive review, as judged by the Engineer, is required caused by complicated, numerous or repetitive requests, Contractor shall reimburse Engineer and its Consultants for such review at their standard billing rates.

I. Substitution Submittal Procedure:
   1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The LP Consulting Engineers, Inc. will notify in writing of decision to accept or reject request.
   4. Present each substitution individually. If a proposed substitute in not found to be acceptable, then the specified item shall be supplied.

1.14 OPERATION AND MAINTENANCE MANUALS

A. See Section 01700 Closeout Submittals for Operation and Maintenance Manual requirements.

B. Provide operating and maintenance instructions, diagrams and parts lists for all components of all mechanical systems and each piece of equipment furnished under these specifications.

C. Operating and maintenance instructions shall be furnished for the following equipment and systems:
   1. Ventilating Systems.
   2. Air Conditioning Systems.
   3. Piping Systems.
   4. Temperature Controls Systems.
   5. Motors.
   6. Testing, Adjusting, and Balancing Reports.

D. Provide manufacturer's model number, design data, capacities, etc. for each piece of mechanical equipment furnished as a part of the Work.

E. The operating instructions shall include procedures for starting, stopping and emergency manual operation for all equipment and systems.

F. Provide maintenance instructions of each item of individual equipment including applicable maintenance data as recommended by the manufacturer, including frequency of lubrication, lubricants, inspections required, adjustment procedures, belt and pulley sizes, etc.

G. Provide manufacturer's parts bulletins with part numbers for each item of equipment included in the Work. Parts bulletins shall be specific to the equipment provided. Extraneous information that does not apply to the equipment provided shall be eliminated from the literature.

H. Include copies of test reports (startup, check, etc.) and inspections performed for each piece of equipment provided in the Work.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in TRUSD's name and registered with manufacturer.

J. Provide supplier and manufacturer contacts, telephone numbers and addresses in the front portion of the operation and maintenance manual.

1.15 PROJECT RECORD DOCUMENTS

A. See Section 017700 - Closeout Procedures.

B. Provide red-lined drawings accurately showing location of equipment and devices and size and routing of ductwork. Include notes explaining installed condition for complete understanding.

1.16 QUALITY ASSURANCE

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from LP Consulting Engineers, Inc. before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

1.17 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.18 WARRANTY

A. See Section 01700 - Closeout Procedures, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 QUALITY AND CARE

A. All materials shall be new and in perfect condition when installed unless specifically indicated otherwise. Materials shall be tested within the Continental United States by an independent, nationally recognized testing agency and shall be listed in accordance with testing agency requirements. When not otherwise specified, all material shall conform to applicable National Standards (ANSI).

B. All capacities, sizes and efficiency ratings shown on the drawing are minimum.

C. Each category of material or equipment shall be of the same brand or manufacturer throughout the Work wherever possible.

D. The quality of materials and equipment to be provided is defined by the brand names, manufacturers, model and catalog numbers listed on the Drawings and in the Specifications. Contractor shall provide each item listed, of the quality specified, or equal.

E. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

F. Inspect and report concealed damage to carrier within their required time period.

G. Store materials in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect from dirt, water, construction debris, and traffic.

H. Equipment which has been damaged, exposed to weather or is, in the opinion of the Engineer or Owner, otherwise unsuitable because of improper fabrication, storage or installation shall be removed and replaced by this Contractor at his expense.

2.02 ACCESS DOORS

A. Coordinate access door requirements with Section 083113. The more stringent requirements shall govern.

B. Provide access doors where access through floors, walls or ceilings is required to access mechanical, plumbing, control system components, fire dampers and fire alarm system components (such as smoke detectors, fire/smoke dampers, etc.) or other systems requiring access for maintenance, test or observation.
   1. Access doors requiring hand access or access for observation only shall be 14"x14" minimum usable opening.
   2. Access doors where entrance of a service person may be required shall be 24"x30" minimum usable opening.

C. Established standard: Milcor of types listed below. Other acceptable manufacturers: Cesco, J.L. Industries, Karp, Larsen's, or equal. Comply with the following:
   1. Form doors and frames of welded, ground smooth steel construction, 14 gauge for doors, 16 gauge for frames. Provide prime coat finish except for stainless steel type.
   2. Concealed hinges to allow 175 degree opening.
   3. Locks: flush, screw driver operated cam lock(s).
   4. Provide anchoring devices suitable for the construction into which the doors are framed.

D. Application (as applicable):
   1. In gypsum drywall walls and ceilings: Type DW.
   2. In ceramic tile walls: Type MS (stainless steel).
   3. In fire rated walls: Type Fire Rated (rating as required for wall or ceiling), self closing, 250 F in 30 min. temperature rating.

PART 3 EXECUTION

3.01 INSTALLATION

A. Access Doors
   1. Coordinate the exact location of access doors to provide proper access to the item concealed. Obtain written approval for access door locations from Architect.
   2. Coordinate installation of access doors with the trades performing the construction assemblies into which the access doors are placed.
   3. Install all access doors neatly and securely, to open and close completely, and to operate freely and without binding. Install rated doors in accordance with their listing requirements.
   4. Test operate all doors and make all adjustments required for satisfactory operation. Replace all damaged materials.
   5. Install in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with the requirements within this section.

B. Test all piping with no leak or loss in pressure in accordance with the requirements within this section.

3.03 GENERAL TESTING REQUIREMENTS FOR MECHANICAL AND PLUMBING SYSTEMS

A. Contractor shall assign a responsible person to be an independent representative to witness testing and to sign as witness of times, pressure and losses of testing media for all hydronic piping and duct testing.
   1. Test all piping as noted below with no leak or loss of pressure. Repair or replace defective piping until tests are accomplished successfully.
   2. Submit to the Engineer for review a log of all tests made which shall include time, temperature, pressure, water makeup and other applicable readings, necessary to indicate the systems have been operated and tested in the manner outlined in the construction documents.
   3. After producing the specified test pressure, disconnect the pressurizing source; do not introduce further pressure for the duration of the test period, repair leaky piping and retest. Repeat the procedure until the entire system is proven tight.

B. Test the following systems with the medium listed to the pressure indicated for the time period listed:
   1. Hydronic Piping: Pressure=125 Psig / Medium= Water / Duration=4 Hours.

3.04 CUTTING AND PATCHING

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of TRUSD or separate Contractor.

B. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

C. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

E. Restore work with new Products in accordance with requirements of Contract Documents.

F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Code requirements , to full thickness of the penetrated element.

H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.05 PRIMING AND PAINTING

A. Apply primer to all exposed ferrous metals that are not factory primed, factory finished, galvanized, stainless steel or anodized. Exposed black steel piping shall be primed and finish painted to match Architectural finsih requirements.

1. Primer shall be as recommended by the paint manufacturer for each specific application.
2. Acceptable Products include: Fuller O'Brien Blox-Rust Metal All Purpose Primer, equivalent Rust-Oleum product, or equal. See Section 092216 for other acceptable products.

B. Apply two coats of primer to metal surfaces of items to be insulated or jacketed, except ductwork and piping, or factory primed or finished.

C. Preparation:
1. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
2. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; seal stains and marks which cannot be completely removed using Devoe KILSTAIN primers, shellac, or other coating acceptable to paint manufacturer any marks or defects that might bleed through paint finishes.
3. Remove mildew from impervious surfaces by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow substrate to thoroughly dry.
4. Galvanized Surfaces:
   a. Remove surface contamination and oils by solvent cleaning in accordance with SSPC-SP 1 and allow to dry.
   b. Apply Devoe MIRROLAC Galvanized Metal Primer in accordance with manufacturer instructions.
5. Uncoated Steel And Iron Surfaces:
   a. Remove grease, rust, scale, and dust from steel and iron surfaces using solvent in accordance with SSPC-SP 1.
   b. Where heavy coatings of scale or contaminants are evident, hand tool clean in accordance with SSPC-SP 2 or use other approved SSPC SP method as needed.
6. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate Devoe MIRROLAC metal primer or primer recommended by manufacturer.

D. Application:
1. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
2. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
3. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

E. Finish Painting: See Section 09900.

3.06 STARTING EQUIPMENT AND SYSTEMS/COMMISSIONING

A. Start equipment and systems in accordance with manufacturer's written instructions..

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to TRUSD's designated representative.

D. Description:
1. Comply with all start up of mechanical and electrical equipment systems as required in the various sections and herein.

2. Coordinate all testing and startup procedures with all other trades so that all non-mechanical and non-electrical work is completed and operational so that the specified testing can be performed.

E. Preliminary Work:
   1. Prior to the startup, the Contractor shall ensure that the systems are ready to operate, and the following items have been completed and checked including but not limited to:
      a. Proper motor and pump rotation.
      b. Flushing and cleaning of the system.
      c. Wiring
      d. Auxiliary connections
      e. Lubrication.
      f. Venting.
      g. Controls.
      h. Installation of filters and strainers.
      i. Setting of relief and safety valves .
   2. All electrical testing must be completed and test results submitted before equipment startup to avoid power interruptions during mechanical equipment startup and testing.
   3. The Contractor shall submit at least 10 days in advance a schedule listing the date of completion of his work as it will be ready for equipment startup of Electrical/Mechanical equipment. This schedule shall include work on a system by system, floor by floor basis.
   4. Two weeks prior to the startup of any major equipment, the Contractor shall certify in writing that the systems will be complete and ready for startup. Completeness shall not only include physical installation of individual pieces of equipment, but all related elements of other crafts to make all equipment operate as a system.
      a. The startup checklist will cover all related crafts, e.g., controls, electrical, mechanical, and a clean environment for equipment startup.
   5. The Contractor shall schedule a tour with the Owner's representative and the Engineer to review startup conditions prior to equipment startup. This tour shall take place during the associated Engineer's regularly scheduled visit. This tour does not relieve the Contractor of any responsibilities to properly start equipment. The Engineer will issue a notice of deficiencies that will be required to be corrected prior to equipment startup. The Contractor will be required to reschedule a back check with the Engineer prior to attempting an equipment startup.
   6. Equipment of systems should not be started until systems and associated subsystems are completed. Verify that other continuing work could not possibly damage completed systems if they are in operation. Furnish signed off prestartup check sheet.

F. Startup and Commissioning:
   1. System Startup and Operation:
      a. The Contractor shall provide all labor, materials and services necessary for the initial startup and operation of all systems and equipment furnished and installed under this section.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic 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 A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2014 (Reapproved 2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

I. MFMA-4 - Metal Framing Standards Publication 2004.

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

K. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
   a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
   b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Piping up to 1 inch (27 mm) nominal: 3/8 inch diameter.
   c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
   d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
1. General Construction and Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
   c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
   d. Insulation inserts to consist of calcium silicate insulation surrounded by a 360 degree, PVC jacketing.
2. PVC Jacket:
   a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
   b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   c. Thickness: 60 mil.

E. Pipe Supports:
1. Liquid Temperatures Up To 122 degrees F:
   a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
   b. Support From Below: MSS SP-58 Types 35 through 38.
2. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 Types 35 through 38.

F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
   1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
   2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

G. Riser Clamps:
   1. Provide copper plated clamps for copper tubing support.
   2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

H. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

I. Strut Clamps: Two-piece pipe clamp.

J. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

K. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
   1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
   2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

L. Pipe Alignment Guides: Galvanized steel.
   1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
   2. Pipe Diameter 10 inches and Larger: Roller type.

M. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

N. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
   1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
   4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

O. Pipe Shields for Insulated Piping:
   1. General Construction and Requirements:
      a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
      b. Shields Material: UV-resistant polypropylene with glass fill.
      c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
      d. Minimum Service Temperature: Minus 40 degrees F.
      e. Maximum Service Temperature: 178 degrees F.
      f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

P. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.04 SUBMITTALS

A. See Section 013300 - Submittal Procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Nameplates.

C. Control Panels: Nameplates.

D. Dampers: Ceiling tacks, where located above lay-in ceiling.

E. Heat Transfer Equipment: Nameplates.

F. Major Control Components: Nameplates.

G. Piping: Pipe markers.

H. Pumps: Nameplates.

I. Small-sized Equipment: Tags.

J. Tanks: Nameplates.

K. Thermostats: Nameplates.

L. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Seton Identification Products: www.seton.com/aec.

2.03 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.

2. Letter Height: Air Handling Units, Control panels: 1 inch.
3. Letter Height: All others: 1/4 inch.
4. Background Color: Black.
5. Plastic: Comply with ASTM D709.

2.04 TAGS

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

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

2.05 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Secure to pipe using two (2) bands of adhesive tape with flow arrows supplied by the manufacturer. Install securing bands completly around pipe and overlapped.

C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.06 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
1. Fire Dampers and Smoke Dampers: Red.
2. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

D. Identify fans and filter boxes with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

E. Identify chilled/hot water equipment, including chillers, boilers, pumps, expansion tanks, air separators, etc. with plastic nameplates.

F. Identify air conditioning units, air handling units, heating and ventilating units, exhaust fans, pumps, heat transfer equipment, tanks, fire/smoke damper access doors, and water treatment devices with nameplates. Small devices, such as terminal units, in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify thermostats/sensors relating to fan unit and/or zone unit with nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate

identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.04 SUBMITTALS

A. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit to LP Consulting Engineers, Inc. within 2 days after completion of testing, adjusting, and balancing.
   2. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   3. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   4. Units of Measure: Report data in I-P (inch-pound) units only.
   5. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE Std 111, or NEBB forms.
   6. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.
      d. Project name.
      e. Project location.
      f. Project Engineer.
      g. Project altitude.
      h. Report date.

B. Test and balance shall be performed by an independent test and balance agency.

C. Perform total system balance in accordance with AABC MN-1, ASHRAE Std 111, or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

D. TAB Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience certified by AABC or NEBB.

E. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work and licensed at the .

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
   3. SMACNA (TAB).

B. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

C. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
      b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 TESTING, ADJUSTING, AND BALANCING AGENCIES

A. RS Analysis, 916-358-5673.

B. Raglen System Balance.

3.03 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.

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.

3.04 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to LP Consulting Engineers, Inc. to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.05 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

3.06 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

C. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

D. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by TRUSD.

3.07 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

E. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

F. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

G. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.08 SCOPE

A. Test, adjust, and balance the following:
   1. Air Handling Units.
   2. Fans.
   3. Air Filters.
   4. Air Inlets and Outlets.

3.09 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.

B. Cooling Coils:
   1. Location.
   2. Service.
   3. Manufacturer.
   4. Air flow, design and actual.
   5. Entering air DB temperature, design and actual.
   6. Entering air WB temperature, design and actual.
   7. Leaving air DB temperature, design and actual.
   8. Leaving air WB temperature, design and actual.
   9. Saturated suction temperature, design and actual.
   10. Air pressure drop, design and actual.

C. Air Moving Equipment:

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

D. Return Air/Outside Air/Exhaust Air:
1. Identification/location.
2. Design air flow (determined by inital test)
3. Actual air flow.
4. Design return air flow (determined by inital test)
5. Actual return air flow.
6. Design outside air flow (determined by inital test)
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Actual mixed air temperature.

E. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

C. Insulation jackets.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

B. Section 23 31 00 - HVAC Ducts and Casings: Ductwork.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation 2020.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.

B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.

C. The requirements of this Section apply to all Work of Division 23.

D. Section 013300 - Submittals.

1.05 SUBMITTALS

A. See Section 013300 - Submittals, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.07 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.

1.08 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

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
1. Owens-Corning Fiberglas; Model [All Service Faced Duct Wrap].
2. Knauf Insulation: www.knaufinsulation.com.
3. Johns Manville: www.jm.com/#sle.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Duct Application: 2" thick, 3/4 pound density.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.029 ng/Pa s m (0.02 perm inch), when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
1. Knauf Insulation: www.knaufinsulation.com.
2. Johns Manville: www.jm.com/#sle.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.

3. Maximum Water Vapor Absorption: 5.0 percent.
4. Density: 3.0 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.04 JACKETS

A. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.020 inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.05 DUCT LINER

A. Manufacturers:
1. Knauf Insulation: www.knaufinsulation.com.
2. Johns Manville: www.jm.com/#sle.
3. Owens Corning Corp: www.owenscorning.com.

B. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket; impregnated surface and edges coated with acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
2. Duct Application (Indoors): 1" thick, 1-1/2 pound density.
3. Duct Application (Outdoors): 2" thick, 1-1/2 pound density.
4. Service Temperature: Up to 250 degrees F.
5. Acoustical Requirements
a. Sound absorption coefficients of the material (with and/or without erosion resistive coating) shall be greater than or equal to the coefficients listed in the specifications when tested under the specified conditions.
b. All acoustical measurements shall be performed in accordance with ANSI/ASTM C423 and shall be performed in the ASTM E795 mounting configuration as indicated.
c. An independent acoustical laboratory shall perform the tests.
d. The sound absorption coefficient provided by the material shall meet or exceed the following values in each octave band listed:
6. Thickness, 1 inch Hz/Coefficient: 125/.05, 250/.20, 500/.65, 1k/.90, 2k/.95, 4k/.95.

C. Liner Fasteners: Galvanized steel, welded with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Insulated Ducts Conveying Air Below Ambient Temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or with standard vapor barrier jacket.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Liner shall start within 3 inches of the upstream transverse edges of the liner and 3 inches from the longitudinal joints, and shall be spaced at a maximum of 12 inches on center around the perimeter of the duct (except that they shall be a maximum of 12 inches from a corner break). Elsewhere, they shall be a maximum of 18 inches on center, except that they shall not be placed more than 6 inches from a longitudinal joint of the liner or 12 inches from a corner break. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for spacing.
3. Seal and smooth joints. Seal and coat transverse and longitudinal joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are inside dimensions and do not include consideration for liner thickness.

3.03 SCHEDULES

A. Supply and Return Ducts: Insulate all unlined supply ducts, except ducts exposed in conditioned spaces.

B. Exterior Applications:
1. Supply and Return Ducts exposed to outdoors to be internally lined except ductwork conveying direct evaporatively cooled air.
2. Supply and Return ductwork exposed to outdoors for direct evaporatively cooling systems to be externally insulated. Cover insulation with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

C. Supply and Return Ducts: Install lining on ductwork and plenums where shown or noted on drawings.

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

B. Section 07 84 00 - Firestopping.

C. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 22 13 - Steam and Condensate Heating Piping: Placement of hangers and hanger inserts.

E. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.

C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.

D. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing 2010 (Reapproved 2016).

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 13300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.02 GLASS FIBER, RIGID

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufusa.com.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible.
   1. "K" value: ASTM C 177:
      a. 0.24 to 0.28 at 100 degrees mean rating temperature.
      b. 0.25 to 0.29 at 125 degrees mean rating temperature.
      c. 0.27 to 0.30 at 150 degrees mean rating temperature.
      d. 0.29 to 0.31 at 200 degrees mean rating temperature.
      e. 0.32 to 0.34 at 250 degrees mean rating temperature.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Armacell LLC: www.armacell.us/#sle.
   2. K-Flex USA LLC: www.kflexusa.com/#sle.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETING AND ACCESSORIES

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Pipe saddle.

C. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

3.03 SCHEDULE

A. Heating Systems:
1. Heating Water Supply and Return:
a. Glass FIber Insulation:
1) Pipe Size Range: 2 inches and smaller.
(a) Thickness: 1-1/2 inch.
b. Glass FIber Insulation:
1) Pipe Size Range: 2-1/2" and larger.
(a) Thickness: 1-1/2 inch.

B. Cooling Systems:
1. Chilled Water:
a. Glass Fiber Insulation:
1) Pipe Size Range: 2 inches and smaller.
(a) Thickness: 1-1/2 inch.
2) Pipe Size Range: 2-1/2" and larger.
(a) Thickness: 1-1/2 inch.
b. Glass Fiber Insulation:
1) Pipe Size Range: all sizes.
(a) Thickness: 1-1/2 inch.
2. Refrigerant Suction:

a. Flexible Elastic Cellular Insulation:
    1) Pipe Size Range: 1 inch and smaller.
        (a) Thickness: 1 inch.
    2) Pipe Size Range: 1.25 inch and larger.
        (a) Thickness: 1.5 inch.

3. Refrigerant Hot Gas:
    a. Flexible Elastic Cellular Insulation:
        1) Pipe Size Range: 1 inch and smaller.
            (a) Thickness: 1 inch.
        2) Pipe Size Range: 1.25 inch and larger.
            (a) Thickness: 1.5 inch.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Valves.
E. Strainers.
F. Filter-driers.
G. Flexible connections.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 07 19 - HVAC Piping Insulations.

1.03 REFERENCE STANDARDS

A. AHRI 710 - Performance Rating of Liquid-Line Driers 2009.
B. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers 2013 (Reapproved 2014).
C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2019, with All Amendments and Errata.
D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2020.
F. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service 2020.
G. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.
H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
I. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
J. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

1.04 SYSTEM DESCRIPTION

A. Refrigerant piping, accessories and installation to be per manufacturer's recommendations.
B. 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.
C. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
D. Liquid Indicators:
   1. Use line size liquid indicators in main liquid line leaving condenser.

2. Use line size on leaving side of liquid solenoid valves.

E. Valves:
1. Use service valves on suction and discharge of compressors.

F. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

G. Strainers:
1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. Use shut-off valve on each side of strainer.

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

I. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.05 SUBMITTALS

A. See Section 01300 - Submittals, for submittal procedures.

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

C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Test Reports: Indicate results of leak test, acid test.

E. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.07 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

2.01 PIPING

A. Copper Tube: ASTM B 280, H58 hard drawn, sealed ends.
1. Fittings: ASME B16.22 wrought copper.
2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

B. Pipe Supports and Anchors:
1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Vertical Support: Steel riser clamp.
7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
10. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:
1. Henry Technologies: www.henrytech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.

B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder 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.

2.03 VALVES

A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Henry Technologies: www.henrytech.com/#sle.
3. Flomatic Valves: www.flomatic.com/#sle.

B. Packed Angle Valves:
1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Ball Valves:
1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.04 STRAINERS

A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.

B. Straight Line or Angle Line Type:
1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.05 FILTER-DRIERS

A. Manufacturers:

1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.
2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com/#sle.
3. Sporlan, a Division of Parker Hannifin: www.parker.com/#sle.

B. Performance:
1. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
2. Design Working Pressure: 350 psi, minimum.

C. 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.

D. Construction: UL listed.
1. Connections: As specified for applicable pipe type.
2. Shell: ARI 710, UL listed, brass removable cap for maximum working pressure of 350 psi (2410 kPa).
3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina, ARI 730 rating for capacity.

2.06 FLEXIBLE CONNECTORS

A. Manufacturers:
1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk/#sle.
2. Flexicraft Industries: www.flexicraft.com/#sle.
3. Penflex: www.penflex.com/#sle.

B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

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

F. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.5.
2. Steel hanger rods and clevis shall be cadmium or zinc plated.
3. Support horizontal piping as indicated.
4. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
5. Place hangers within 12 inches of each horizontal elbow.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.

G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access to concealed valves and fittings.

J. Flood piping system with nitrogen when brazing.

K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

L. Insulate piping and equipment; refer to Section and Section 23 07 16.

M. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

N. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

O. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

Q. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Test refrigeration system in accordance with ASME B31.5.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

B. Section 230713 - Duct Insulation.

C. Section 23 33 00 - Air Duct Accessories.

D. Section 23 37 00 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 126 - Method of Testing HVAC Air Ducts 2020.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.

G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.

H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

I. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines 2001.

J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

L. UL 1978 - Grease Ducts Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.

B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.

C. The requirements of this Section apply to all Work of Division 23.

D. Section 013300 - Submittals.

1.05 SUBMITTALS

A. See Section 013300 - Submittals, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all ductwork systems. Provide 1/4"=1'-0" ductwork layout plans showing duct routing, offsets, fittings, duct accessories, fire/smoke dampers, hydronic piping, seismic bracing, etc. Shop drawings shall by fully coordinated with all other trades, including the building structure, finishes, fire sprinkler piping, plumbing piping, hydronic piping and electrical systems.

D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.07 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

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

2.02 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.
4. Manufacturers:
   a. Carlisle HVAC Products: www.carlislehvac.com/#sle.
   b. Design Polymerics: www.designpoly.com.com/#sle.
   c. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

C. Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle rings connections.

D. Ducts: Galvanized steel, unless otherwise indicated.

E. Low Pressure Supply (Heating Systems): 2 inch wg pressure class, galvanized steel.

F. Low Pressure Supply (System with Cooling Coils): 2 inch wg pressure class, galvanized steel.

G. Medium and High Pressure Supply: 4 inch w.g. pressure class, galvanized steel.

H. Return and Relief: 1 inch wg pressure class, galvanized steel.

I. Outside Air Intake: 1/2 inch wg pressure class, galvanized steel.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, 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 air foil turning vanes of perforated metal with glass fiber insulation.

D. Round ductwork shall be spiral lockseam, 24 gauge minimum. Round ductwork exposed within occupied spaces shall be spiral lockseam, 20 gauge minimum.

E. Rectangular ductwork exposed within occupied spaces shall be 20 gauge minimum.

F. Ductwork exposed within occupied spaces shall be internally sealed to provide a clean exterior appearance.

G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

H. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

I. Fittings shall be spot welded and internally sealed.

J. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Manufacturers:
      a. EHG, a DMI Company: www.ehgduct.com/#sle.
      b. Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
      c. MKT Metal Manufacturing: www.mktduct.com/#sle.
      d. McGill Airflow.

B. Round Ducts: Round lockseam duct with galvanized steel outer wall.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Manufacturers:
      a. EHG, a DMI Company: www.ehgduct.com/#sle.
      b. Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
      c. MKT Metal Manufacturing: www.mktduct.com/#sle.
      d. McGill Airflow.

C. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
   1. Manufacturers:
      a. Carlisle HVAC Products: www.carlislehvac.com/#sle.
      b. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Duct sizes indicated are outside dimensions. For lined ducts, duct sizes must be increased to account for lining.

E. Indoor Applications: Seal all standing seams and transverse joints in all sheetmetal ductwork with Hardcast "Iron Grip" premium flexible water based duct sealant.

F. Outdoor Applications: Seal all standing seams and transverse joints in all sheetmetal ductwork with Hardcast Model Duct Seal 321 premium flexible water based duct sealant with UV inhibitors.

G. Seal all standing seams and transverse joints in all sheetmetal ductwork with Hardcast DT tape, 4 inches wide, and Hardcast FTA-20 adhesive.

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

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

J. Connect diffusers boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
B. Section 23 31 00 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
E. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.
F. UL 1978 - Grease Ducts Current Edition, Including All Revisions.

1.04 RELATED SECTIONS

A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
B. The Contract Agreement, Bidding Documents and all Addenda issued prior to Contract Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the mechanical systems.
C. The requirements of this Section apply to all Work of Division 23.
D. Section 013300 - Submittals.

1.05 SUBMITTALS

A. See Section 013300 - Submittals, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.

1.06 PROJECT RECORD DOCUMENTS

A. Record actual locations of access doors and test holes.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

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

1.08 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES

A. Manufacturers:
   1. ProRail, Ductmate Industries, Inc.
   2. Duro Dyne Corp.

B. Manufactured turning vanes with 2" single thickness curved blades set at 1-1/2" on-center mounted in 2" vane rails, self-aligning, hot dipped galvanized steel.

C. Turning vanes, vane rails and mounting shall be constructed and installed in accordance with the SMACNA "HVAC Duct Construction Standards".

2.02 DUCT ACCESS DOORS

A. Manufacturers:
   1. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. Ward Industries, a brand of Hart and Cooley, Inc: www.wardind.com/#sle.
   4. or equal.

B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
   1. High Temperature Duct Access Doors:
      a. Comply with NFPA 96.
      b. Comply with UL 1978.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.03 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.

2.04 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:
   1. Carlisle HVAC Products: www.carlislehvac.com/#sle.
   2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections (Indoors): Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.
   2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

D. Flexible Duct Connections (Outdoors): Fabric crimped into metal edging strip.
   1. Fabric: Ventfabrics Ventlon UL listed fire-retardant duPont's Hypalon coated woven glass fiber fabric to NFPA 90A, minimum density 26 oz per sq yd, sunlight, ozone and weather resistant.
      a. Net Fabric Width: Approximately 3 inches wide.
   2. Metal: 3 inches wide, 24 gage thick galvanized steel.

2.05 VOLUME CONTROL DAMPERS

A. Manufacturers:
   1. Nailor Industries, Inc: www.nailor.com/#sle.
   2. Ruskin Company: www.ruskin.com/#sle.
   3. United Enertech: www.unitedenertech.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Single Blade Dampers for Round Ductwork and Rectangular Ductwork up to 10 inches in Height: 18 gauge steel minimum.

D. Multi-Blade Damper for Rectangular Ductwork: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware; Model CD35 Manufactured by Ruskin. Provide Ruskin Model CD50 for installation in medium pressure ductwork and/or ducts with velocities exceeding 1500 FPM.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings, Ventlok Model 607. On multiple blade dampers, provide oil impregnated nylon or sintered bronze bearings.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.

B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. Provide balancing dampers at points on supply, return, outside air and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

E. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 54 00
FURNACES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Forced air furnaces.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

B. Section 23 51 00 - Breechings, Chimneys, and Stacks: Flue or stack.

C. Division 26 - Equipment Wiring Systems: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.03 REFERENCE STANDARDS

A. NFPA 54 - National Fuel Gas Code 2015.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.

D. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances 2016.

1.04 SUBMITTALS

A. See Section 01300 - Submittals, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

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 TRUSD's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience and approved by manufacturer.

1.06 WARRANTY

A. See Section 01700 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturers warranty for solid state ignition modules and controls.

C. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation, a brand of United Technologies Corporation Building & Industrial Systems: www.carrier.com/#sle.

B. York International Corporation / Johnson Controls: www.york.com/#sle.

C. or equal.

2.02 GAS FIRED FURNACES

A. Units: High efficiency condensing furnace, self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, and accessories; wired for single power connection with control transformer.
   1. Air Flow Configuration: Horizontal.
   2. Heating: Natural gas fired.
   3. Electric Refrigeration: Refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.

B. Furnace unit shall be AGA certified.

C. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner. For counterflow units, provide additive steel base.

D. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

E. Motor: Refer to Section 15065; 1750 rpm single speed, permanently lubricated, hinge mounted.

F. Heat Exchanger: Stainless steel clamshell type welded construction with aluminum finned stainless steel tube condensing coil.

G. Gas Burner:
   1. Atmospheric type with adjustable combustion air supply,
   2. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
   3. Electronic pilot ignition, with electric spark igniter.
   4. Combustion air damper with synchronous spring return damper motor.
   5. Non-corrosive inducer blower with permanently lubricated motor.

H. Gas Burner Safety Controls:
   1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
   2. Flame rollout switch: Installed on burner box and prevents operation.
   3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
   4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

I. Operating Controls
   1. Room Thermostat: Cycles burner to maintain room temperature setting.
   2. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation. Provide continuous low speed fan operation.

J. Air Filters: 2 inch (50 mm) thick glass fiber, disposable type arranged for easy replacement.

K. Performance:
   1. Ratings: Energy Efficiency Rating (EER) not less than requirements of ASHRAE Std 90.1; seasonal efficiency to ASHRAE Std 103.
   2. Refer to Furnace Schedule. Gas heating capacities are sea level ratings.

PART 3 EXECUTION

3.01 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 located correctly.

C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

B. Install in accordance with NFPA 90A.

C. Install gas fired furnaces in accordance with NFPA 54 and NFPA 58.

D. Provide vent connections in accordance with NFPA 211.

E. Provide and install CPVC piping for combustion air intake and flue for gas furnaces where scheduled and as shown on the drawings. Install in accordance with manufacturer's installation instructions.

END OF SECTION

SECTION 23 63 13
AIR COOLED REFRIGERANT CONDENSERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured units.

B. Casing.

C. Condenser coils.

D. Fans and motors.

E. Controls.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2019, with All Amendments and Errata.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

E. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

B. Product Data: Provide rated capacities, weights, accessories, electrical requirements, and wiring diagrams.

C. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

D. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in TRUSD's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

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

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

B. Protect units on site from physical damage. Protect coils.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp: www.carrier.com/#sle.

B. York International Corporation/Johnson Controls, Inc: www.york.com/#sle.

C. or equal.

2.02 MANUFACTURED UNITS

A. Provide packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil liquid accumulator.

B. Construction and Ratings: In accordance with AHRI 210/240and UL 207. Testing shall be in accordance with ASHRAE Std 20.

C. Performance Ratings: Energy Efficient Rating (EER)/Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1 I-P, in combination with compressor units.

2.03 CASING

A. House components in welded steel frame with steel panels with weather resistant, baked enamel finish.

B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners.

2.04 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen.

2.05 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge, equipped with roller or ball bearings with grease fittings extended to outside of casing.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built-in current and thermal overload protection; refer to Section 23 05 13.

2.06 CONTROLS

A. Provide factory wired and mounted control panel, NEMA 250, containing fan motor starters, fan cycling thermostats, compressor interlock, and control transformer.

B. Provide controls to permit operation down to 0 degrees F ambient temperature.

C. Provide thermostat to cycle fan motors in response to outdoor ambient temperature.

D. Provide head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service. Refer to Section 26 05 83.

C. Provide connection to refrigeration piping system. Refer to Section 23 23 00. Comply with ASHRAE Std 15.

D. Provide cooling season start-up, winter season shut-down service, for first year of operation.

E. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

END OF SECTION

SECTION 23 74 13
PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged Air Conditioning Unit.

1.02 RELATED REQUIREMENTS

A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.

B. Division 16 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.

B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment 2015, with Addendum.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

D. Unit shall be designed to conform to ASHRAE 15, latest revision, and in accordance with UL 1995.

E. Units shall be UL tested and certified in accordance with ANSI Z21.47 Standard. Units may be ETL listed.

F. New roof curbs shall be designed to conform to NRCA Standards.

G. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

1.04 SUBMITTALS

A. See Section 01300 - Submittals, for submittal procedures.

B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up 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 manufacturer's warranty and ensure forms have been filled out in TRUSD's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.07 WARRANTY

A. See Section 01700 - Contract Closeout, for additional warranty requirements.

B. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

C. Provide a one year warranty to include coverage for refrigeration compressors.

D. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

E. Provide five year limited warranty for heat exchanger including materials only.

F. Furnish one complete set of fan motor drive belts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Packaged Air Conditioning Units
   1. The Carrier Corporation.
   2. York International, Inc..
   3. or equal.

2.02 PACKAGED AIR CONDITIONING UNITS

A. General
   1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
   2. Factory assembled, single piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
   3. Unit shall use R-410a refrigerant.
   4. Unit shall be installed in accordance with the manufacturer’s instructions.
   5. Unit must be selected and installed in compliance with local, state, and federal codes.
   6. Unit shall meet ASHRAE 90.1 and IECC minimum efficiency requirements.
   7. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
   8. Unit shall be designed to conform to ASHRAE 15.
   9. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL or ETL-listed and certified under Canadian standards as a total package for safety requirements.
   10. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
   11. Unit internal insulation linings shall be resistant to mold growth in accordance with “mold growth and humidity” test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the “Erosion Test” in UL 181, as part of ASTM C1071.
   12. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
   13. Roof curb shall be designed to conform to NRCA Standards.
   14. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
   15. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
   16. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.

B. Delivery, Storage, and Handling:
   1. Unit shall be stored and handled per manufacturer's recommendations.
   2. Unit shall only be stored or positioned in the upright position.

C. Operating Characteristics:
   1. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 340/360 at ± 10% voltage.
   2. Compressor with standard controls shall be capable of operation from 35°F (2°C), ambient outdoor temperatures. Accessory kits are necessary if mechanically cooling at ambient temperatures below 35°F (2°C).

D. Unit Cabinet:
   1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.
   2. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment.
   3. Unit internal insulation linings shall be resistant to mold growth in accordance with "mold growth and humidity" test in ASTM C1338, G21, and UL 181 or comparable test method. Air stream surfaces shall be evaluated in accordance with the "Erosion Test" in UL 181, as part of ASTM C1071.
   4. Condensate Pan and Connections:
      a. Shall be a sloped condensate drain pan made of a non-corrosive material.
      b. Shall comply with ASHRAE Standard 62.
   5. Gas Connections:
      a. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location.
   6. Electrical Connections:
      a. All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
   7. Component Access Panels (standard):
      a. Cabinet panels shall be easily removable for servicing.

E. Gas Heat:
   1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
   2. Shall incorporate a direct-spark ignition system and redundant main gas valve.
   3. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
   4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
   5. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame roll-out switch or 4 continuous short cycles on the high temperature limit switch.
   6. Standard Heat Exchanger Construction:
      a. Heat exchanger shall be of the tubular-section type constructed of a minimum of 20-gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.
   7. Optional Stainless Steel Heat Exchanger Construction:
      a. The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a mini-mum of 20-gauge type 409 stainless steel.
   8. Optional Low NOx Heat Exchanger Construction:

a. Low NOx reduction shall be provided to reduce nitrous oxide emissions to meet California's Air Quality Management District (SCAQMD) low-NOx emissions requirement of 40 nanograms per joule or less.

F. Coils:
1. Standard Aluminum Fin/Copper Tube Coils:
a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
2. Optional Pre-Coated Aluminum-Fin Condenser Coils:
a. Shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments.
b. Corrosion durability of fin stock shall be confirmed through testing to be no less than 1000 hours salt spray per ASTM B117-90.

G. Refrigerant Components:
1. Refrigerant circuit shall include the following control, safety, and maintenance features:
a. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
b. Refrigerant filter drier.
c. Service gauge connections on suction and discharge lines.
2. Compressors:
a. Unit shall use fully hermetic, scroll compressors.
b. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
c. Compressors shall be internally protected from high discharge temperature conditions.
d. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
e. Compressor shall be factory mounted on rubber grommets.
f. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
g. Crankcase heaters shall be utilized on all models to protect compressor with specific refrigerant charge.

H. Filter Section:
1. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.
2. Filters shall be standard, commercially available sizes.

I. Evaporator Fan and Motor:
1. Evaporator fan motor:
a. Shall have permanently lubricated bearings.
b. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
c. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.
2. Evaporator fan:
a. Blower fan shall be double-inlet type with forward-curved blades.
b. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

J. Condenser Fans and Motors:
   1. Condenser fan motors:
      a. Shall be a totally enclosed motor.
      b. Shall use permanently lubricated bearings.
      c. Shall have inherent thermal overload protection with an automatic reset feature.
   2. Condenser fans:
      a. Shall be a direct driven propeller type fan and shall be dynamically balanced.

K. Special Features Options and Accessories:
   1. Low Ambient Controller:
      a. Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
      b. Shall consist of solid-state control and condenser-coil temperature sensor to maintain condensing temperature at outdoor ambient temperatures down to 0°-F (–18°-C). (Not available on 11 size models as standard unit cooling operation down to 0°-F /–18°-C).
   2. Condenser Coil Hail Guard Assembly:
      a. Shall protect against damage from hail.
      b. Shall be of louvered style.
   3. Flue Discharge Deflector:
      a. Flue discharge deflector shall direct unit exhaust vertically instead of horizontally.
      b. Deflector shall be defined as a “natural draft” device by the National Fuel and Gas (NFG) code.
   4. Economizer:
      a. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory-installed option.
      b. Ultra low leak design meets California Title 24 and, ASHRAE 90.1 and IECC requirements.
      c. Shall be capable of introducing up to 100% outdoor air.
      d. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
      e. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
      f. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
      g. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1-2016 and IECC-2015 requirements.
      h. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
      i. Dampers shall be completely closed when the unit is in the unoccupied mode.
      j. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
      k. Combined minimum and DCV maximum damper position potentiometers with compressor staging relay.
      l. On-board Fault Detection and Diagnostics (FDD) that senses and alerts when the economiz-er is not operating properly, per California Title 24.
      m. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also avail-able on factory-installed only. Outdoor air

sensor setpoint shall be adjustable and shall range from 40 to 100°F (4 to 38°C). Additional sensor options shall be available as accessories.

5. Power Exhaust:
   a. Power exhaust shall be used in conjunction with an integrated economizer.
   b. Independent modules for vertical or horizontal return configurations shall be available.
   c. Horizontal power exhaust shall be mounted in return ductwork.
   d. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0 to 100% adjustable setpoint on the economizer control.
6. Roof Curbs (Vertical):
   a. Welded seismic galvanized steel curb with wood nailer strip and shall be capable of supporting entire unit weight.
   b. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
7. Winter Start Kit:
   a. Shall contain a bypass device around the low pressure switch.
   b. Shall be required when mechanical cooling is required down to 25°F (–4°C).
   c. Shall not be required to operate on an economizer when below an outdoor ambient of 40°F (4°C).
8. Anti-short Cycle Timer:
   a. Shall prevent compressor short cycling by providing a 5-minute delay (±2 minutes) before restarting a compressor after shutdown for any reason.
   b. One device shall be required per compressor.
9. Hinged Access Panels:
   a. Shall provide easy access through integrated quarter turn latches.
   b. Shall be on major panels of — filter, control box, fan motor and compressor

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that proper power supply is available.

3.02 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.

3.03 SYSTEM STARTUP

A. Provide factory start-up and supervise installation by Contractor.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 CONTRACT PROVISIONS

A. The requirements of this Section are in addition to the requirements of Division 1, General Conditions and Supplementary Conditions.

1.02 SUMMARY

A. This section describes the requirements for the electrical work includes, among others, the furnishing and installation of the following:
   1. Electrical service from the Main Switchboard to the building Distribution Panel(s) including transformer(s), conduit and trenching, conductors.
   2. Power distribution system.
   3. Grounding system.
   4. Lighting and lighting control systems.
   5. Wiring systems including power wiring to plumbing and HVAC and other misc. appliances and equipment.
   6. Electrical services for Communications management system. (voice/video/media/clock) as described in Division 27 and as indicated on the drawings.
   7. Electrical services for Computer data systems, as described in Division 28 and as indicated on the drawings to include outlets, raceways, and cabling.
   8. Electrical services for Intrusion alarm and security systems as described in Division 28 and as indicated on the drawings.
   9. Emergency egress lighting.
   10. Fire alarm system.
   11. Emergency Power System.
   12. Photovoltaic System.
   13. Testing and commissioning for all electrical work installed under this contract and as described in these specifications and indicated on the drawings.

B. Furnish and install all electrical equipment and systems as shown on the Drawings and as described in this Division of the Specifications to provide a complete and functional electrical installation. This work includes but is not limited to all material and labor required for installation of electrical and special systems complete as described herein this specification and drawings; and connections (and installation where not otherwise provided for) of electrical equipment furnished by others. Provide and install all items of equipment, devices, supports, etc., which are incidental to the major components shown on the Drawings or described in these Specifications.

C. Related Sections

D. Section 26 08 13 – Acceptance Testing

1.03 DEFINITIONS

A. The meaning of words shall be as defined in the CEC Article 100, Definitions, unless defined otherwise in an individual specification section.

B. The following specification development organizations are referenced throughout the various specification sections of Division 26:
   1. AASHTO – American Association of State Highway and Transportation Officials.
   2. ADAAG – Americans with Disabilities Act Accessibility Guidelines.
   3. Air Pollution Control District, Air Quality Management District.
   4. ANSI – American National Standards Institute.
   5. AQMD – Air Quality Management District.
   6. APCD – Air Pollution Control District.
   7. ASME – American Society of Mechanical Engineers.
   8. ASTM – American Society for Testing and Materials.
   9. CBC – California Building Code.
   10. 10. CCR – California Code of Regulations Title 24 State Chapters.
   11. 11. CEC – California Electrical Code.
   12. 12. CFC – California Fire Code.
   13. 13. CMC – California Mechanical Code.
   14. 14. CSA – Canadian Standards Association.
   15. 15. EIA – Electronic Industries Association.
   16. 16. FCC – Federal Communications Commission.
   17. 17. FM – Factory Mutual.
   18. 18. FS – Federal Specifications.
   19. 19. ICEA – Insulated Cable Engineers Association.
   20. 20. IEC – International Electromechanical Commission.
   21. 21. IEEE – Institute of Electrical and Electronic Engineers.
   22. 22. IETA – International Electrical Testing Association.
   23. 23. ISA – Instrument Society of America.
   24. 24. ISO – International Organization for Standardization.
   25. 25. MIL – Military Specifications.
   26. 26. NACE – National Association of Corrosion Engineers.
   27. 27. NECA – National Electrical Contractors Association.
   28. 28. NEMA – National Electrical Manufacturing Association.
   29. 29. NETA – National Electrical Testing Association.
   30. 30. NFPA – National Fire Protection Association.
   31. 31. NIST – National Institute of Standards and Technology.
   32. 32. OSHA – Occupational Safety and Health Administration.
   33. 33. SMACNA – Sheet Metal and Air Conditioning Contractors National Association Inc.
   34. 34. UL – Underwriters Laboratories.

1.04 RELATED WORK INCLUDED IN OTHER DIVISIONS

A. Finish painting except factory applied finishes and repair of factory finishes shall be provided in accordance with appropriate sections of this Specification. Coordinate "painting" requirements of this Division with other trades as required to assure timely and satisfactory completion of required work. In finished areas, all exposed raceway, boxes, galvanized steel box covers (where allowed), and other electrical "structure" shall be finished to match adjacent structures. Verify

that all raceway openings are closed and box covers are in place prior to finishing work done by others.

B. Examine the drawings and specification for mechanical and plumbing equipment and provide electrical installation for heating, ventilation and air conditioning equipment, motors, pumps and associated motor starters and controls as described in Division 22 and Division 23.

C. Examine the Architectural drawings and specification for electrical appliances and equipment which may not be shown on the plans to include and provide electrical installations as described in the architectural division of work.

D. Examine the Architectural drawings and provide all construction necessary to maintain the integrity of the fire rated barriers.

E. Examine the Architectural drawings and coordinate with the Architect to provide access doors, whether shown on drawings or not, where floors, walls, or ceiling must be penetrated for access to electrical equipment, outlet boxes, devices, etc., and as specified in this specification.

F. Provide and install, as part of the work described in this Division, all power and control wiring fed from a source of 30 Volts or more (i.e. all wiring except temperature control wiring) for mechanical equipment described in Division 23.

G. Examine the fire sprinkler system drawings and specifications for electrical work which may not be shown on the electrical and/or fire detection and alarm plans to be included in the electrical work as necessary as described in the Division 21 fire sprinkler system.

1.05 APPLICATION OF OTHER DIVISIONS

A. Where carpentry, masonry, concrete work, painting, etc., is required in the installation of equipment specified under this Division, the work shall be done in accordance with the applicable Division of these Specifications. This work could include for example: work associated with panelboard installation, equipment pads or bases, support structures, etc.

1.06 DRAWINGS AND SPECIFICATIONS

A. The information presented in these Specifications, and on the drawings, is intended to describe the utilitarian and physical aspects of the systems shown as well as the quality of the entire installation. All information is as complete and thorough as possible, but every condition or situation cannot be anticipated. Exact locations, dimensions, elevations, etc. must be determined "on the job" with careful attention to the "intent" of the Drawings and Specifications.

B. The above paragraph shall not be construed as to allow significant deviation from either the Drawings or Specifications without prior approval of the Architect, but minor changes in conduit routing or equipment locations may be required or desired due to specific conditions encountered. This work shall be accomplished in accordance with these Specifications and no "extra charges" are to be created for any unanticipated labor or material.

C. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical systems.

D. Contractor shall inspect the site and verify all measurements and conditions. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.
   1. The Drawings are diagrammatic in nature, but the locations of devices, equipment, outlets, and lighting fixtures are shown approximately where installations are intended. Architectural, structural, mechanical, audio/video, theatrical lighting and other drawings shall be examined, noting all conditions that may affect this work. Report conflicting conditions to the Architect/Engineer for adjustment before proceeding with the work. Should the Contractor proceed with work without reporting the matter, he does so on his own responsibility and shall alter work if directed by the Architect/Engineer at his own expense.

E. Examine the architectural, structural, mechanical, fire sprinkler and manufacturer's drawings for various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.

F. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to rough in without incurring any additional cost or changes.

G. If significant departures from the Drawings or Specifications are considered necessary by the Contractor, details of the changes and the reasons therefore shall be submitted to the Architect as within thirty days after award of contract. Prior written acceptance of the Architect is required for these departures.

H. Clarification of plans and specifications for the purpose of facilitating construction, but not involving additional labor and materials, may be prepared during construction by the Architect/Engineer. Said revised plans and specifications shall become a part of the contract. The Contractor shall conform to the revised plans and specifications at no additional cost to the Owner.

1.07 CODES, STANDARDS, RULES AND REGULATIONS

A. All work and materials shall be in full accordance with the latest rules, codes, and/or regulations and not limited to the following:

B. CEC – California Electrical Code.

C. NFPA 101 - Life Safety Code

D. NFPA 72 - Fire Alarm Code

E. Title 24 - State of California Administrative Code

F. Uniform Building Code (UBC) OR California Building Code (CBC)

G. City or County Electrical Code as applicable.

H. Utility rules and regulations.

I. Any applicable additional codes and regulatory documents effective at the project site.

J. Nothing on the Drawings or in the Specifications shall be construed to allow work not in conformance with these rules, codes, and regulations.
   1. The Drawings and/or Specifications shall take precedence where work and material described therein exceeds that required by rules, codes, or regulations.

1.08 MANUFACTURER'S INSTRUCTIONS

A. Follow the manufacturer's instructions when specific installation or connection details are not indicated or specified on the contract documents.

B. Notify the Architect/Engineer of conflicts between the manufacturer's instructions and installation or connection details prior to the installation of materials.

1.09 WORKMANSHIP

A. High quality workmanship shall be evidenced in the installation of all electrical equipment and materials. Use the National Electrical Contractors Association's "Standard of Installation" as a guide to the workmanship required. Be prepared to replace or repair any material or equipment damaged by or installed in a manner exhibiting evidence of poor workmanship.

1.10 COORDINATION WITH OTHER TRADES

A. Examine the Electrical Drawings and refer to the Drawings and Specifications describing other work to be accomplished. Verify and coordinate prior to bid. Continue to coordinate work planning and all work in the field to avoid conflicts, errors, and/or delays. No compensation will be allowed for extra work necessitated by lack of coordination.

1.11 AUTHORITY OF THE ARCHITECT

A. As used in this paragraph only, the word "Architect" shall mean the Architect of record or his designated representative.

B. The authority of the Architect shall be absolute with respect to all performance under this Specification. In case of dispute, the decision of the Architect shall be final.

C. Where optional materials, methods, or installation techniques are allowed under the provisions of this Specification, they may be used at the discretion of the Architect. The Architect may require specific materials, methods, or techniques to be used in specific situations where use of other materials, methods, or techniques might in his judgment result in loss of aesthetics, accidental damage, life safety hazard, or loss of utility over the system design lifetime.

D. No additional charges will be allowed for work or material require to be supplied under the conditions of this paragraph unless the need for such material or work could not have been anticipated by thorough study of the site, Drawings, and Specifications and knowledge of all applicable codes, laws, and ordinances.

1.12 EXAMINATION OF THE SITE

A. The contractor is required to visit the site of construction prior to bid to determine existing conditions and their effect upon the work he will be required

to perform. No additional compensation will be allowed for any extra expenses incurred by failure to detect and evaluate all existing conditions that will affect his work to be included in the bid to accomplish this contract document's goal.

1.13 STRUCTURAL REQUIREMENTS

A. Secure all anchors for electrical equipment in a manner, which will not decrease the structural value of any structure to an unsafe level. Install all equipment, fixtures, etc. to resist seismic movements. Inform the Architect in advance and provide drawings of any proposed modifications to the structure that involves cutting or patching of concrete, masonry, steel, or wood in this project.

1.14 PERMITS, FEES, AND, INSPECTIONS

A. Obtain all permits and licenses as required and pay all fees incidental to construction.

B. Inspections required by prevailing Local Authorities, and/or ordinances, shall be coordinated and arranged by the contractor. Provide the Architect with a schedule of inspections, where applicable, and submit all certificates of inspection to the Architect.

C. The Contractor shall cooperate with the Architect and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate equipment, or perform any reasonable work, which, in the opinion of the Architect, will be necessary to determine the quality or adequacy of the work. Work shall not be closed in or covered before inspection and approval by the Architect. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Architect, remove the materials from the premises.

1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable to the Owner. Secure material from weather or accidental damage.

1.16 SEQUENCING AND SCHEDULING

A. Sequence work under provisions of Division 1.

B. Coordinate the incoming electrical, telephone and cable television services with the local serving utility companies. Install utility service trench and duct systems in accordance with the respective serving utility company requirements.

C. Coordinate hand hole locations with the existing site conditions. Hand holes are to be located approximately five feet from building or as indicated on drawings.

1.17 SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

A. The contractor shall provide short circuit, protective device and arc flash studies for the complete electrical distribution system. Submit to the Electrical Engineer of Record for review. Provide all short circuit device and equipment characteristic information for all electrical components. Provide Time-Current curves for all overcurrent protective devices in the submittal. Set and adjust all

devices in accordance with the results of this study prior to energizing equipment. Refer to Section 26 05 73, Power Systems Studies for additional requirements.

B. The Contractor shall be responsible for obtaining all pertinent information necessary in order to perform the required short circuit, protective device coordination and arc flash studies to include but not limited to the following:
   1. Contacting the serving power utility to obtain the available short circuit current at the project point of connection and/or secondary of the serving utility company service transformer(s).
   2. Field investigation to determine the short circuit current rating for any existing electrical service and distribution equipment.
   3. Electrical characteristics for all proposed new electrical service and distribution equipment.
   4. The Contractor shall provide approved permanent labels for all electrical service and distribution equipment to clearly identify the available short circuit current and arc flash energy levels and required PPE (Personnel Protective Equipment).

1.18 OPERATING INSTRUCTIONS

A. Instruct the Owner as to function, operation, maintenance, and adjustment of each system and piece of equipment provided.

1.19 RECORD DRAWING

A. The Contractor shall keep a separate set of Electrical Drawings at the job site to be used as RECORD Drawings. These Drawings are to be kept current and in a neat and clean condition at all times. They are to be available for inspection by the Architect or Engineer at any time during site visitations. These Drawings shall be "red lined" to indicate all changes in equipment, device, and outlet locations; and to indicate the true locations of all concealed or underground work where different from that shown on the Drawings. Each sheet of this set shall be clearly and permanently marked "RECORD DRAWINGS".

B. Upon completion of the project and prior to final payment, transfer all RECORD DRAWINGS information to the provided original drawings. All information shall be clearly drawn with “RED” ink. The drawings shall be scanned, 100% edited, and converted into an AutoCAD “.dwg” version 2011 (or higher) electronic file. Deliver the original, final sets, and electronic files (CD) to the Architect for review and delivery to the Owner.

1.20 SPARE PARTS

A. Spare parts shall be provided and maintained by the Contractor to support the maintenance response requirements defined in this document.

B. At a minimum, the following spare parts shall be stored onsite at a location identified by the Owner’s representative. The spare parts shall be the property of the Owner. The spare parts shall be of the same type submitted and installed in the facility to include the following:

C. Lighting fixture LED driver, one for each fixture type.

D. Branch circuit panelboard circuit breaker, one for each circuit breaker type.

E. Fuses, one set of three for each fuse type and size.

F. Lighting occupancy sensors and switches, one for each sensor and switch type.

1.21 GUARANTEE

A. All electrical work, material, and equipment shall be guaranteed to be free from defects in workmanship or material for a period of two (2) year from the date of final acceptance. Repair or replace all such defects in a timely manner and any damage to the owner's property resulting from such defect or repair thereof. All equipment and material provided and all work accomplished under the requirements of this section shall be at no expense to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless specifically indicated otherwise, all material shall be new and free from defects; it shall be listed by Underwriters' Laboratories where applicable. Like items shall be of the same manufacturer (except lighting fixtures - which shall be as specified).

B. Except as noted otherwise, where material of a particular manufacturer is specified, the intent is to describe the quality and function of the item. The term "...or acceptable equal" is implied. A substitution of any of these items will require that the item be presented in a submittal whether specifically listed in the "Submittals" paragraph below or not.

2.02 SUBMITTALS

A. Material submittals shall be complete and submitted all at the same time. The individual groups of submittal types (e.g.: lighting fixtures, wiring devices, distribution equipment, etc.) MUST be prefaced with a list of contents identifying each item by its project name or symbol, manufacturer, and complete catalog number. Each copy of each submittal group shall have the list of contents attached. These lists will be used to report submittal comments. The Contractor is responsible for submitting this information in a timely manner so that material may be ordered early enough to meet the construction schedule. If material is not ordered in time for whatever reason, pay such premium prices and special handling charges as are required to meet the construction schedule. No substitution of an "accepted" item will be allowed due to failure to plan for adequate material procurement lead time.

B. Shop drawings shall be drawn to scale or completely dimensioned and shall give all information required to completely describe the item. The Contractor shall carefully check all the shop drawings for compliance with these specifications and the Plans.

C. If the shop drawings show variations from the Contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in order that if (acceptable) suitable action may be taken for proper adjustment of the Contract. The Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract, even though the shop drawings have been reviewed.

D. Work requiring shop drawings shall not be started before receipt of the Architect's review and acceptance.

E. The Architect's/Engineer's review of the submitted materials, items and shop drawings are for general compliance with the plans and specifications and general design and arrangement only. Therefore, it shall not relieve the Contractor from responsibility for errors of any sort in the materials, items, shop drawings or schedules. The Contractor shall verify all dimensions and job site conditions affecting the work, and shall be responsible for furnishing and installing the proper materials required by the Contract, whether or not indicated on the drawings and specifications.

F. As a minimum, submittals are required for the following items:
   1. RACEWAY COMPONENTS
   2. WIRE AND CABLE
   3. WIRING DEVICES
   4. MAIN SWITCHBOARD AND DISTRIBUTION PANELS
   5. PANELBOARDS
   6. PHOTOVOLTAIC SYSTEM
   7. PULL BOXES
   8. SAFETY SWITCHES, DISCONNECTS AND CIRCUIT BREAKERS
   9. TRANSFORMERS
   10. LIGHTING FIXTURES, CONTROL SYSTEMS, PEDESTALS AND POLES
   11. FIRE ALARM SYSTEM
   12. COMMUNICATIONS SYSTEM
   13. SECURITY SYSTEM
   14. DATA DISTRIBUTION SYSTEM
   15. TERMINAL CABINETS
   16. EMERGENCY GENERATOR AND TRANSFER SWITCH(ES)

2.03 SUBSTITUTIONS

A. Specific brand names and catalog numbers are used to describe materials in order to establish of performance and quality.

B. Only one substitution will be considered for any item. Substitute materials must be equal in quality and function to that specified. Allowance of a substitution does not permit any reduction of system performance or utility, and the Contractor is responsible for additional costs incurred due to use of a substituted item. If the proposed substitute item is "rejected", the specified item shall be provided (re-submittal required) without further discussions or delay.

C. Any Contractor's proposed substitution of material, article, or method in the opinion of the Architect/Engineer are equal to that specified will be accepted, provided the Contractor submits a single written request, in triplicate, to the Architect, with the following information for each item:

D. Name of Manufacturer or supplier.

E. Trade or brand names.

F. Type, model, style, and/or catalog number.
   1. Size or capacity rating.

G. After receipt of a written request from the contractor, the engineer of record will review product substitutions fourteen (14) days prior to the bid date. If system substitutions are submitted after the award of the project contract, the analysis for the whole system substitution will be charged to the contractor at senior engineer hourly rates.

H. The decision of the Architect/Engineer shall govern as to what is equal to the item specified in the plans and specifications. Equality will be judge on the basis of the following:
   1. Conformance with description or performance required.
   2. Equal in quality.
   3. Comparable in appearance and artistic effect where these are in considerations.
   4. Comparable operation, maintenance and performance.
   5. Equal in longevity and service under conditions of climate and usage.
   6. Conformance with space allocations and requirements for operations from in details and construction of related work.
   7. Conformance with all applicable codes and regulations.

I. If the Architect/Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Architect.

2.04 ENCLOSURES

A. Provide enclosures suitable for the specific type of location in which they are installed.
   1. Provide NEMA 1 or NEMA 12 boxes and enclosures for dry locations. Dry locations are all indoor areas that do not fall within the definitions below for wet or damp locations.
   2. Provide NEMA 3R boxes and enclosures for wet locations. Wet locations are all locations exposed to weather, whether under a roof or not.
   3. Provide NEMA 4 boxes and enclosures for damp locations. Damp locations are all indoor spaces wholly or partially underground or any area subject to water spray.
   4. Provide NEMA 4X, stainless steel enclosures in all kitchen and wash down areas.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All equipment shall be set square and plumb, securely mounted, adequately supported, and permanent. Provide workspace around items of electrical equipment as required by California Electrical Code (CEC). In general, equipment is to be installed in accordance with manufacturer's instructions; but the requirements of these specifications shall take precedence where conflicts exist.

B. WIRING METHODS: The cables and conductors of all systems specified in the Specification are required to be installed in raceway.

C. Coordinate electrical work with the Owner's representative and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the facility during construction.

D. Check and coordinate the approximate locations of electrical stub-ups, light fixtures, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the architect in writing. The architect's decision shall govern. Make modifications and changes required to correct conflicts as required.

3.02 ELECTRICAL WORK FOR EQUIPMENT PROVIDED UNDER OTHER SECTIONS

A. Install power conductors and terminate on equipment provided under other specification sections. Verify specific requirements.

B. Install and terminate electrical controls as described on the Electrical Drawings (For mechanical equipment specified in Division 23).

C. Line voltage control wiring of exhaust fans is to be accomplished under this Division. The controlling device may be specified elsewhere.

D. Provide and install all disconnect/safety switches and motor starters except those devices specified to be furnished with equipment specified elsewhere.

E. Unless provided for in another Division, install all items of electrical equipment provided by others.

F. Assist others in equipment testing to verify that wiring and connections made under this Division are correct.

3.03 EQUIPMENT IDENTIFICATION

A. Nameplates shall be installed on all items of electrical equipment as follows: switchboard(s) and switchboard circuit breakers, panelboards, terminal cabinets, time switches, contactors, motor control switches, wall switches (where noted on the Drawings), motor starters provided under this Division where the function is not immediately obvious, and safety switches.

B. The nameplate shall identify the item by Drawing name where applicable and describe its use or function in this installation.

C. Permanently mark all utility outlets to show source of power panel and circuit breaker number.

D. Provide nameplates per Section 26 05 53.

3.04 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be accomplished as required for installation of electrical equipment as shown on the Drawings. Restore all surfaces, roadways, walks, etc., and any existing underground structures which might be disturbed during this work to their original condition in a manner acceptable to the Architect.

B. Trenches shall be straight except where otherwise indicated. Depth shall be as noted on the Drawings and at least as required to provide the minimum cover specified by applicable codes and regulations for the equipment installed.

Bottom of trench shall be smooth and free of any rock points. Place a 4" sand bed in trench if these conditions cannot be met with native material.

C. Backfill shall be clean and free of rocks and debris. Backfill is to be tamped in 6" layers to nominal 95% compaction using a mechanical tamper manufactured specifically for this purpose. In an area of engineered fill or other area of specified compaction, backfill shall be compacted to match that specified for that area.

D. At a depth of 12" below finished grade and at least 6" above installed equipment, lay a 6" wide yellow warning tape on the compacted backfill for the full length of the trench. Do not stretch the tape. Use Brady "Identoline" stating: "CAUTION BURIED ELECTRICAL LINE". Installation under building slabs is not required unless noted otherwise.

E. If at any time during a period of one-year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, the Architect may notify the Contractor to immediately provide additional fill and to make such repairs or replacements in paving, planting, or structures, as may be deemed necessary at the Contractor's expense.

F. Cooperate and coordinate with others in planning for and execution of all trench work.
   1. The Contractor is expected to exercise due care when excavating in an area of existing utilities to avoid damage to these facilities. Where it can be determined that underground facilities are likely to exist (either from the Drawings or inspection of the site), the Contractor is required to determine the exact locations of these existing installations. Damage to existing facilities, due to failure to properly accomplish the above, shall be repaired at the Contractors expense to the approval by the Architect and satisfaction of the Owner.
   2. CALL AN UNDERGROUND SERVICE FIRM BEFORE TRENCHING, CALL U.S.A. (800) 624-2444.

3.05 SEALING PENETRATIONS

A. Flash and counter flash roof and wall penetrations with equipment manufactured for the purpose and as described in other Divisions of these Specifications or as Directed by the Architect. Apply mastic as required to seal absolutely watertight.

B. Conduits penetrating floor slabs or block or concrete walls shall be grouted and sealed watertight.

3.06 CUTTING AND PATCHING

A. Obtain the Architect's acceptance prior to cutting existing surfaces or surfaces under construction. All such surfaces must be repaired or patched to the satisfaction of the Architect.

3.07 EQUIPMENT ANCHORING

A. Seismic Withstand Requirements: Freestanding or wall-hung equipment shall be anchored in place by methods, which will meet the requirements of the Uniform Building code for seismic loads. The CONTRACTOR shall submit calculations in accordance with “Contractor Submittals”, for the design of the

anchoring systems for all equipment, including panels, transformers, etc. in excess of 250 pounds. Calculations shall be performed, signed and stamped by a Structural Engineer or a Civil Engineer experienced in structural design and licensed in the State of California. The calculation shall provide an analysis of lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. The calculation shall also provide an analysis of both the anchoring system and the foundation or wall system to receive the anchor loads and shall show that the foundation is capable of resisting all anchor loads. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria.

B. Seismic bracing for light fixtures cable or pendant suspended from ceiling or roof structure shall be seismically braced to prevent fixture from swaying 45 degree in either direction of suspension point. Contractor shall use same cable used to suspend light fixture. Where pendants are use the contractor shall use air craft light fixture suspension cable. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria referred to in above paragraph.

3.08 HOUSEKEEPING PADS AND FOUNDATIONS

A. Concrete work required for housekeeping pads and foundations shall be provided by General Construction Work.

B. Furnish required dimensional drawings and specify locations for all equipment pads and foundations. Minimum height of housekeeping pads shall be four inches and shall extend out six inches from the footprint of the equipment. Extend pad dimensions where required to maintain accessibility and meet all code requirements.

C. Furnish anchor bolts and sleeves, verify accuracy of installation.

D. Provide housekeeping pads for the following:
   1. Outdoor switchboards.
   2. Emergency and/or Stand-by generator.
   3. Outdoor distribution panels.
   4. Outdoor floor mounted transformers.
   5. Other equipment as required or as noted on the drawings.

3.09 PROTECTION CLEANING AND REPAIRS

A. All electrical equipment shall be protected from damage or degradation during construction. Electrical equipment stored or installed shall be protected from dust, water, or damage from other sources.

B. After all other work has been accomplished, such as plastering, painting, etc., and prior to final review by the Architect; all electrical equipment, especially equipment enclosures, panelboards, switchboards, and lighting fixtures shall be thoroughly cleaned (inside and out) of all dirt, water, grease, plaster, paint, or other construction debris. All surfaces shall be clean and in "new" condition. All scratches, dents, marks, cracks, etc., shall be repaired to the satisfaction of the Architect or the equipment shall be replaced at no additional cost.

3.10 ELECTRICAL EQUIPMENT DELIVERABLES

A. Retain and safeguard all detachable and spare devices, equipment, and literature (O&M manuals, instruction books, wiring diagrams, test reports, keys, fixtures, etc.) until completion of work. At this time, all items will be delivered to the Owner as directed by the Architect.

3.11 TESTS

A. Prior to energization of equipment, check the insulation resistance of listed circuits, with a 500 volt “Megger”.

B. Take precaution during the testing period to insure the safety of personnel and equipment.

C. Test all wiring for continuity and grounds before any fixtures or equipment are connected. Where such tests indicate faulty installation or other defects, the fault(s) shall be located and repaired at the Contractor's expense. The repaired installation shall then be retested.

D. Verify rotation of all three phase motors and reconnect if necessary.

E. Verify the resistance of the grounding electrode system(s).

F. Balance all loads on each panelboard and all other types of distribution equipment as applicable.

G. Provide all site testing under provisions of Section 26 08 13.

3.12 ADJUSTING

A. Adjust work under provisions of Section 26 08 13.

B. Inspect all equipment and put into good working order.

3.13 CLEANING

A. Clean work under provisions of Division 1.

B. Clean all electrical items. Fixtures and equipment shall be free of dirt, dust and other construction debris.

3.14 START UP

A. Operate all electrical systems in good working order for a period of five consecutive days at a time period agreed to by the Owner’s representative.

END OF SECTION

SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

B. The requirements of this Section are in addition to the requirements of Division 1 – General Conditions and Supplementary Conditions.

1.02 RELATED REQUIREMENTS

A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

B. Section 02 84 00-Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

C. Section 26 05 00-Common Work Results for Electrical.

1.03 SUBMITTALS

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

B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

1.04 REQUIREMENTS INCLUDED

A. The Contractor shall furnish materials, equipment, and labor necessary to perform and complete demolition work.

B. The work includes demolition of the existing electrical and fire alarm systems and equipment.

C. The work shall include, but not limited to. Removal of existing electrical and fire alarm equipment and devices, conduits, and wiring.

D. Manufactured articles, materials, equipment, and accessories shall be demolished in accordance with the manufacturer’s specifications ad recommendations, and industry standards.

E. Notify the Owner’s Representative at least 72 hours prior to any electrical systems shutdown and receive approval prior to proceeding.

1.05 PROTECTION

A. It is essential that there be minimal interruption of existing systems such as power, fire protection, and other systems, in addition to the normal operations of the Owner’s facilities.

B. Take care to ensure that there will be no damage to structural elements or portions there-of-which are not to be removed. Erect and maintain temporary shoring, bracing and other means to safeguard the structural integrity of the existing building(s) and structures.

C. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other means to protect the public, workers, and other persons; finishes, and

improvements to remain; and adjoining property from damage from demolition work; all in accordance with applicable regulatory requirements.

D. Protect existing structures, facilities, and plant life from damage. Items damaged as a result of demolition operations shall be repaired or replaced, at no cost to the Owner.

E. Perform demolition to provide the least interference and most protection to existing facilities and improvements to remain.

F. Demolish concrete in small sections.

G. Perform demolition as much as possible with small tools.

H. Jackhammering:
   1. Jackhammering will be permitted only to a limited degree, and only with the prior written approval of the Owner.
   2. Do not jackhammer within 2-inches of reinforcing or structural steel to remain; remove final 2-inches of material with chipping gun.

1.06 CUTTING AND PATCHING

A. Make new openings neat, as close as possible to profiles indicated, and only to extent necessary for new work.

B. Do not cut or alter structural members unless specifically indicated or approved, and do not damage reinforcing or structural steel to remain.

C. At concrete, masonry, paving, and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power-sawing and coring equipment. Do not over cut at corners of cut openings – saw overruns will not be permitted. Core hole at corner of proposed openings to insert blade and chip square.

D. Upon completion of cutting and coring, clean remaining surfaces of loose particles and dust.

E. Repair and patch all holes and openings from the removed electrical equipment, outlet boxes, etc.: Coordinate with the General Contractor and Architect to include and provide finishes to match adjacent surfaces.

1.07 PIPES, DUCTS AND CONDUITS

A. Remove deactivated electrical conduits, including fasteners, connections, and other related appurtenances and accessories which would otherwise be exposed in the completed work or interfere with construction operations.

B. Unless noted otherwise, remove existing exposed conduits and abandon existing concealed conduits in walls, ceilings and underground whether shown on drawings or not.

C. Cap deactivated piping systems at point of cutoff.

1.08 DEMOLITION DEBRIS

A. All demolished equipment and associated materials must be disposed of in an approved manner and in accordance with all applicable federal, state and local laws.

B. Regularly remove debris from the site so that it’s presence will not delay the progress of the work.

C. Nothing removed from the site shall be stored, sold, or burned on site without the Owner's prior written acceptance.

1.09 RECONDITIONING EXISTING SUBSTRATES

A. Clean surfaces on which new materials will be applied, removing adhesives, bitumen, and other adhering materials, as necessary to furnish acceptable substrates for new materials.

B. Perform sandblasting, chipping, grinding, acid washing, etching, and other work as required by conditions encountered and new materials involved.

C. Use of acids or other cleaning agents shall include neutralizing, washing, rinsing, and drying, as applicable.

D. Determine substrate requirements for reconditioned surfaces in cooperation with the manufacturer's representative and installer of each new installer involved.

1.10 DISPOSAL OF FLUORESCENT LAMPS AND BALLASTS

A. All existing fluorescent lamps and ballasts shall be properly disposed or recycled according to the Environmental Protection Agency (EPA) and Resource Conservation and Recovery Act (RCTA) standards. Include all costs for disposal or recycling in the bid proposal.

1. Lamps: Dispose or recycle through "Allied Technology Group", 47375 Freemont Blvd., Freemont, CA, 94538, (510) 490-3008 or equal.
2. Ballasts: Dispose or recycle through "Fulcircle Ballast Recyclers", 550 Montori Court, Pleasanton, CA, 94556, (510) 417-5967 or equal.

1.11 ASBESTOS

A. In the event asbestos is found to be present in areas conflicting with electrical work, before continuation of work in these areas, notify the General Contractor and/or Owner's Representative and if applicable, for the removal of such hazardous material by a certified asbestos contractor.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on field observation and existing record documents.

D. Report discrepancies to Architect and Owner before disturbing existing installation.

E. Report discrepancies to Electrical Engineer on Record before disturbing existing installation.

F. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner Representative at least 24 hours and receive approval before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain campus existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner's Representative before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner's Representative at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

G. Existing data, clock and intercom and other Systems: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission fromOwner's Representative at least 24 hours before partially or completely disabling system.
   2. Obtain permission from Owner's Representative at least 24 hours before partially or completely disabling system.
   3. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.

2. PCB- and DEHP-containing lighting ballasts.
3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION 260501

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Scope: furnish all labor, materials, equipment, and incidentals required to install wire and cable for a complete operable electrical system as shown on the drawings and as described in the specifications.

B. Section Includes:
   1. Single conductor building wire
   2. Nonmetallic-sheathed cable.
   3. Underground feeder and branch-circuit cable.
   4. Service entrance cable.
   5. Armored cable.
   6. Metal-clad cable.
   7. Power and control tray cable.
   8. Variable-frequency drive cable.
   9. Photovoltaic wire.
   10. Manufactured wiring systems.
   11. Wire and cable for 600 volts and less.
   12. Wiring connectors.
   13. Electrical tape.
   14. Heat shrink tubing.
   15. Oxide inhibiting compound.
   16. Wire pulling lubricant.
   17. Cable ties.
   18. Firestop sleeves.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 00-Common Work Results for Electrical.

C. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

D. Section 26 05 13 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.

E. Section 26 05 19.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.

F. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

G. Section 26 05 36 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.

H. Section 31 2316 - Excavation.

I. Section 31 2323 - Fill: Bedding and backfilling.

J. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

K. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.

L. Section 26 31 00 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.

M. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

N. Section 31 23 16 - Excavation.

O. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

P. Section 31 23 23 - Fill: Bedding and backfilling.

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 B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers 2005 (Reapproved 2021).

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation 2018.

G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.

H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.

I. CEC – California Electrical Code.

J. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation) 2008a (Validated 2019).

K. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

L. NECA 104 - Standard for Installing Aluminum Building Wire and Cable 2012.

M. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable 2018.

N. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF) 2007.

O. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.

P. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

Q. NFPA 79 - Electrical Standard for Industrial Machinery 2021.

R. UL 4 - Armored Cable Current Edition, Including All Revisions.

S. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

T. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

U. UL 183 - Manufactured Wiring Systems Current Edition, Including All Revisions.

V. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

W. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

X. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.

Y. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables Current Edition, Including All Revisions.

Z. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

AA. UL 719 - Nonmetallic-Sheathed Cables Current Edition, Including All Revisions.

BB. UL 854 - Service-Entrance Cables Current Edition, Including All Revisions.

CC. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members Current Edition, Including All Revisions.

DD. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.

EE. UL 2277 - Outline of Investigation for Flexible Motor Supply Cable and Wind Turbine Tray Cable Current Edition, Including All Revisions.

FF. UL 4703 - Standard for Photovoltaic Wire 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 the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   4. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.

D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.

E. Product Data: Provide for each cable assembly type.

F. Test Reports: Indicate procedures and values obtained.

G. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

H. Field Quality Control Test Reports.

I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

K. Maintenance Materials: Furnish the following for TRUSD's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

L. Project Record Documents: Record actual locations of components and circuits.

1.06 QUALITY ASSURANCE

A. Comply with requirements of CEC.

B. All wire and cable shall comply with applicable standards of the Underwriters Laboratories Inc.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify the Electrical Engineer or Record and obtain direction before proceeding with work.

1.09 PROJECT CONIDTIONS

A. Existing Conditions
   1. Wire and cable routing shown on the Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
   2. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

B. Verify that field measurements are as shown or indicated on the Drawings.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by CEC and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
      b. Use power and control tray cable or metal-clad cable for installation in cable tray.
      c. Use variable-frequency drive cable for connection between variable-frequency motor controllers and associated motors.
      d. Use pre-manufactured armored cable where indicated on drawings for connections to systems furniture or similar equipment.

C. Nonmetallic-sheathed cable is not permitted unless specifically indicated on the drawings and permitted by CEC.
   1. Where not otherwise restricted, may be used:
      a. For branch circuit wiring in dry locations within one- and two-family dwellings and their attached or detached garages, and their storage buildings.
      b. For branch circuit wiring in dry locations within multifamily dwellings permitted to be of Types III, IV, and V construction.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to view.
      b. Where exposed to damage.

c. For damp, wet, or corrosive locations.

D. Underground feeder and branch-circuit cable is not permitted.
   1. Where not otherwise restricted, may be used:
      a. For damp, wet, or corrosive locations as a substitute for CEC, Type NMC nonmetallic-sheathed cable, when nonmetallic-sheathed cable is permitted.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to view.
      b. Where exposed to damage.

E. Service entrance cable is not permitted.
   1. Where not otherwise restricted, may be used:
      a. For overhead service drop, installed in raceway to service head.
      b. For underground service entrance, installed in raceway.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to damage.

F. Armored cable is not permitted.
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet.
      b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
      c. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.
      d. Connections to systems furniture.
   2. In addition to other applicable restrictions, may not be used:
      a. Unless approved by Owner.
      b. Where not approved for use by the authority having jurisdiction.
      c. Where exposed to view.
      d. Where exposed to damage.
      e. For damp, wet, or corrosive locations.
      f. For isolated ground circuits.

G. Metal-clad cable is not permitted.
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet.
      b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
   2. In addition to other applicable restrictions, may not be used:

a. Unless approved by the Owner.
b. Where not approved for use by the authority having jurisdiction.
c. Where exposed to view.
d. Where exposed to damage.
e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.
g. For patient care areas of health care facilities requiring redundant grounding.

H. Manufactured wiring systems are permitted only as follows:
1. Where not otherwise restricted, may be used:
a. For branch circuits where concealed under raised floors, where concealed above accessible ceilings for lighting, and in open ceiling areas for lighting.
1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
b. For general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities, when provided with additional insulated grounding conductor for redundant grounding.
2. In addition to other applicable restrictions, may not be used:
a. Unless approved by the Owner.
b. Where not approved for use by the authority having jurisdiction.
c. Where exposed to view.
d. Where exposed to damage.
e. For damp, wet, or corrosive locations.
f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

I. Concealed Dry Interior Locations: Use only building wire in raceway.

J. Exposed Dry Interior Locations: Use only building wire in raceway.

K. Above Accessible Ceilings: Use only building wire in raceway.

L. Wet or Damp Interior Locations: Use only building wire in raceway.

M. Exterior Locations: Use only building wire with Type THWN insulation in raceway.

N. Underground Installations: Use only building wire with Type THWN insulation in raceway.

O. Use solid conductor for feeders and branch circuits 10 AWG and smaller.

P. Use stranded conductors for control circuits.

Q. Use conductor not smaller than 12 AWG for power and lighting circuits.

R. Use conductor not smaller than 14 AWG for control circuits.

S. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

T. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 150 feet.

U. Conductor sizes are based on copper unless indicated as aluminum or "AL".

2.02 WIRE MANUFACTURERS (LISTED IN ALPHABETICALLY ORDER ONLY AND NOT NECESSARY BY PREFERENCE)

A. Cerro Wire LLC: www.cerrowire.com.

B. Industrial Wire & Cable, Inc: www.iewc.com.

C. Southwire Company: www.southwire.com.

D. Or Equal.

E. Substitutions: See Section 01 6000 - Product Requirements.

2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of CEC.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Comply with FS A-A-59544 where applicable.

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. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.

I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

L. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
      a. Substitution of aluminum conductors for copper is permitted, when approved by TRUSD and authority having jurisdiction, only for the following:
         1) Services: Copper conductors size 1/0 AWG and larger.

2) Feeders: Copper conductors size 1/0 AWG and larger.

b. Where aluminum conductors are substituted for copper, comply with the following:
   1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
   2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
   3) Provide aluminum equipment grounding conductor sized according to CEC.
   4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.

3. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
4. Tinned Copper Conductors: Comply with ASTM B33.
5. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

M. 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.
2. Control Circuits: 14 AWG.

N. Where conductor size is not indicated, size to comply with CEC but not less than applicable minimum size requirements specified.

O. 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. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.

2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.

c. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B (High-Leg): Orange.
3) Phase C: Blue.
4) Neutral/Grounded: White.

d. 240/120 V, 1 Phase, 3 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Neutral/Grounded: White.

e. Equipment Ground, All Systems: Green.

f. Isolated Ground, All Systems: Green with yellow stripe.

g. Travelers for 3-Way and 4-Way Switching: Pink.

h. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with CEC and is approved by the authority having jurisdiction.

i. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. General Cable Technologies Corporation; [_____]: www.generalcable.com/#sle.
d. Service Wire Co: www.servicewire.com/#sle.
e. Southwire Company: www.southwire.com/#sle.
f. Substitutions: See Section 01 60 00 - Product Requirements.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
a. Encore Wire Corporation: www.encorewire.com/#sle.
b. Southwire Company: www.southwire.com/#sle.
c. Stabiloy, a brand of General Cable Technologies Corporation; [_____]: www.stabiloy.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.
   a. Size 4 AWG and Larger: Type XHHW-2.
   b. Installed Underground: Type XHHW-2.
   c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

F. Conductor: Copper.
   1. For Sizes Smaller Than 4 AWG: Copper.
   2. For Sizes 4 AWG and Larger: Copper.

G. Insulation Voltage Rating: 600 volts.

H. Insulation: CEC, Type THHN/THWN.

2.05 NONMETALLIC-SHEATHED CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

2.06 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Service Wire Co: www.servicewire.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.

C. Provide equipment grounding conductor unless otherwise indicated.

D. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Cable Jacket: Listed and labeled as sunlight resistant.

2.07 SERVICE ENTRANCE CABLE

A. Manufacturers:
   1. Copper Service Entrance Cable:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Service Wire Co: www.servicewire.com/#sle.
      d. Southwire Company: www.southwire.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Aluminum Service Entrance Cable:
      a. Encore Wire Corporation: www.encorewire.com/#sle.
      b. General Cable Technologies Corporation; [_____]: www.generalcable.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Stabiloy, a brand of General Cable Technologies Corporation; [_____]: www.stabiloy.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Service Entrance Cable for Above-Ground Use: CEC, Type SE multiple-conductor cable listed and labeled as complying with UL 854, Style R.

C. Service Entrance Cable for Underground Use: CEC, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2 and with UL 44 Type RHH/RHW-2.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Description: CEC, Type SE.

G. Conductor: Copper.
   1. For Sizes Smaller Than 4 AWG: Copper.
   2. For Sizes 4 AWG and Larger: Copper.

H. Insulation Voltage Rating: 600 volts.

I. Insulation: Type RH.

2.08 ARMORED CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bonding wire.
   1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.

G. Armor: Steel, interlocked tape.

2.09 METAL-CLAD CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Service Wire Co: www.servicewire.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide oversized neutral conductors where indicated or required.

G. Provide dedicated neutral conductor for each phase conductor where indicated or required.

H. Grounding: Full-size integral equipment grounding conductor.
   1. Provide additional isolated/insulated grounding conductor where indicated or required.

I. Armor: Steel, interlocked tape.

J. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.10 POWER AND CONTROL TRAY CABLE

A. Manufacturers:
   1. Encore Wire Corporation: www.encorewire.com/#sle.
   2. General Cable Technologies Corporation; [_____]: www.generalcable.com/#sle.
   3. Okonite: www.okonite.com/#sle.
   4. Service Wire Co: www.servicewire.com/#sle.
   5. Southwire Company: www.southwire.com/#sle.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type TC cable listed and labeled as complying with UL 1277.

C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities

having jurisdiction, provide tray cable marked as Type TC-ER in accordance with CEC.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Insulation: Type XHHW or XHHW-2.

G. Grounding: Full-size integral equipment grounding conductor.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.11 VARIABLE-FREQUENCY DRIVE CABLE

A. Manufacturers:
   1. Service Wire Co; ServiceDrive: www.servicewire.com/#sle.
   2. Or approved equal.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 1000 V.

E. Insulation: Use only thermoset insulation types; thermoplastic insulation types are not permitted.

F. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.

G. Provide metallic shielding.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.12 PHOTOVOLTAIC WIRE

A. Manufacturers:
   1. Service Wire Co; ServiceSolar: www.servicewire.com/#sle.
   2. Or approved equal.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Sunlight-resistant, single-conductor, insulated photovoltaic wire listed and labeled as complying with UL 4703; specifically designed for interconnection wiring of photovoltaic power systems in accordance with CEC.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: As required for photovoltaic power system voltage.

2.13 MANUFACTURED WIRING SYSTEMS

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. D&P Custom Lights & Wiring Systems, Inc: www.dandpcustomlights.com/#sle.
   3. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
   4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Manufactured wiring assemblies complying with CEC Article 604, and listed and labeled as complying with UL 183.

C. Provide components necessary to transition between manufactured wiring system and other wiring methods.

D. Branch Circuit Cables:
   1. Conductor Stranding (Size 10 AWG and Smaller): Solid.
   2. Insulation Voltage Rating: 600 V.
   3. Insulation: Type THHN.
   4. Provide dedicated neutral conductor for each phase conductor where indicated or required.
   5. Grounding: Full-size integral equipment grounding conductor.
      a. Provide additional isolated/insulated grounding conductor where indicated or required.
      b. Provide redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities<> where indicated or required.
   6. Armor: Steel, interlocked tape.

E. Connectors: Keyed and color-coded to prevent interconnection of different voltages.

F. Fixture Leads: Type TFN insulation.

G. Product(s):
   1. As required for the application

2.14 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
   3. Connectors for Aluminum Conductors: Use compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Aluminum Conductors: Use compression connectors for all connections.
7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
8. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

H. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
   1. Manufacturers:
      a. Ideal Industries, Inc: www.idealindustries.com/#sle.
      b. NSI Industries LLC: www.nsiindustries.com/#sle.
      c. Wago Corporation: www.wago.us/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

I. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC; [_____]: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC; [_____]: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
   1. Manufacturers:
      a. Burndy LLC; [_____]: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

L. Power Conductor Splicers
   1. Blackburn.
   2. Burndy “Hylug”.
   3. Ilso.
   4. O.Z. Gedney.

2.15 ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
      c. Or approved equal.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
   3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
   4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
   5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
   6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
   7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
   1. Manufacturers:

a. 3M: www.3m.com/#sle.
b. Burndy LLC; [_____]: www.burndy.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC; [_____]: www.burndy.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. Ilsco: www.ilsco.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. American Polywater Corporation: www.polywater.com/#sle.
c. Ideal Industries, Inc: www.idealindustries.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.
1. Manufacturers:
a. Burndy LLC; [_____]: www.burndy.com/#sle.
b. Scotchflex.
c. Thomas & Betts.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
1. Products:
a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
1. Products:
a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

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 CEC.

D. Verify that raceway installation is complete and supported.

E. Verify that field measurements are as indicated.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean 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 CEC.
   6. Maintain separation of wiring for emergency systems in accordance with CEC.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
      b. Increase size of conductors as required to account for ampacity derating.
      c. Size raceways, boxes, etc. to accommodate conductors.
      d. [_____].
   8. Common Neutrals: Sharing of neutral/grounded conductors among branch circuits is not permitted.
   9. Provide oversized neutral/grounded conductors where indicated and as specified below.
      a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
      b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Install nonmetallic-sheathed cable (Type NM-B) in accordance with NECA 121.

F. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.

G. Install armored cable (Type AC) in accordance with NECA 120.

H. Install metal-clad cable (Type MC) in accordance with NECA 120.

I. 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.

J. Exposed Cable Installation (only where specifically permitted):
   1. Route cables parallel or perpendicular to building structural members and surfaces.
   2. Protect cables from physical damage.

K. Direct Burial Cable Installation:
   1. Provide trenching and backfilling in accordance with Section 31 23 16.13 - Trenching.
   2. Provide trenching and backfilling in accordance with Section 31 23 16 - Excavation and Section 31 23 23 - Fill.
   3. Install cable with minimum cover of 24 inches unless otherwise indicated or required.
   4. Protect cables from damage in accordance with CEC.
   5. Provide underground warning tape in accordance with Section 26 05 53 along entire cable length.

L. Installation in Cable Tray: Also comply with Section 26 05 36.

M. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

N. Secure and support conductors and cables in accordance with CEC 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.

O. Terminate cables using suitable fittings.
   1. Armored Cable (Type AC):
      a. Use listed fittings and anti-short, insulating bushings.

b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

2. Metal-Clad Cable (Type MC):
a. Use listed fittings.
b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

P. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.

Q. Install conductors with a minimum of 12 inches of slack at each outlet.

R. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

S. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

T. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with CEC.

U. 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. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

V. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.

b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.

2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
   a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
   b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
3. Wet Locations: Use heat shrink tubing.

W. Insulate ends of spare conductors using vinyl insulating electrical tape.

X. 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.

Y. Identify conductors and cables in accordance with Section 26 05 53.

Z. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

AA. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

BB. 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.

CC. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

DD. Route wire and cable as required to meet project conditions.
1. Wire and cable routing indicated is approximate unless dimensioned.
2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.

EE. Use wiring methods indicated.

FF. Pull all conductors into raceway at same time.

GG. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

HH. Protect exposed cable from damage.

II. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

JJ. Use suitable cable fittings and connectors.

KK. Neatly train and lace wiring inside boxes, equipment, and panelboards.

LL. Clean conductor surfaces before installing lugs and connectors.

MM. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

NN. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

OO. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

PP. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

QQ. Trench and backfill for direct burial cable installation as specified in Sections 31 2316 and 31 2323. Install warning tape along entire length of direct burial cable, within 3 inches of grade, as specified in Section 26 0553.

RR. Identify and color code wire and cable under provisions of Section 26 0553. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

E. Correct deficiencies and replace damaged or defective conductors and cables.

F. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION 260519

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Scope: provide a complete grounding and bonding system as shown on the electrical drawings and as described in the specifications such that the entire raceway system including all equipment enclosures, data racks, telephone backboards and cabinets, fixtures, and outlets, etc. are effectively connected to ground.

B. Section includes:
   1. Materials and methods for grounding systems and equipment.
   2. Grounding electrodes and conductors.
   3. Equipment ground conductors.
   4. Bonding
   5. Grounding well.
   6. Ground bars.
   7. Chemically enhanced ground electrodes.
   8. Ground plate electrodes.

C. Ground rod electrodes.

D. Chemically-enhanced ground electrodes.

E. Ground plate electrodes.

F. Ground enhancement material.

G. Ground access wells.

H. Pre-fabricated signal reference grids.

I. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Existing metal underground water pipe.
   2. Metal underground water pipe.
   3. Metal frame of the building.
   4. Steel water storage tank and supports.
   5. Concrete-encased electrode.
   6. Ground ring specified in Section 33 7900.
   7. Metal underground gas piping system.

1.02 RELATED REQUIREMENTS

A. Section 09 65 00 - Resilient Flooring: Static control flooring.

B. Section 09 69 00 - Access Flooring.

C. Section 26 05 00-Common Work Results for Electrical.

D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

1. Includes oxide inhibiting compound.

E. Section 26 05 36 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.

F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

G. Section 33 7900 - Site Grounding.

H. Section 03 2000 - Concrete Reinforcing.

I. Section 03 3000 - Cast-in-Place Concrete.

J. Section 26 31 00 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.

K. Section 26 41 13 - Lightning Protection for Structures.

L. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. CEC – California Electrical Code.

B. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NEMA GR 1 - Ground Rod Electrodes and Ground Rod Electrode Couplings 2017.

E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

F. NFPA 99 - Health Care Facilities Code 2021, with Amendment.

G. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2023.

H. 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. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 09 69 00.
   4. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

1. Building grounding electrode: 10 ohms.
2. Separately Derived Sources Grounding Electrode: 10 ohms

1.06 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Product Data: Provide for grounding electrodes and connections.

E. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Field quality control test reports.

H. Project Record Documents: Record actual locations of grounding electrode system components and connections.

I. Project Record Documents: Record actual locations of components and grounding electrodes.

J. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 QUALITY ASSURANCE

A. Comply with requirements of CEC.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 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.

Do not use products for applications other than as permitted by Detail has been deleted as condition does not occur on particular campus."

B. 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 CEC but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Electrical Engineer of Record. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with CEC.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with CEC.
   5. Ground Ring:

a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
c. Provide ground enhancement material around conductor where indicated.
d. Provide connection from ground ring conductor to:
   1) Perimeter columns of metal building frame.
   2) Ground rod electrodes located as indicated.
   3) Building structural steel.

6. Ground Rod Electrode(s):
   a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
   b. Space electrodes not less than 10 feet from each other and any other ground electrode.
   c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
   d. Provide ground enhancement material around electrode where indicated.
   e. Provide ground access well for each electrode.
7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in CEC. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
   b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
   c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in CEC.

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. Separately Derived System Grounding:
   1. Separately derived systems include, but are not limited to:
      a. Transformers (except autotransformers such as buck-boost transformers).
      b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
      c. Generators, when neutral is switched in the transfer switch.
   2. Provide grounding electrode conductor to connect derived system grounded conductor to common grounding electrode conductor ground riser. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
   3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
   4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
   5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with CEC.
   6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
   7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. 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 CEC.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Raceways may be used as sole equipment grounding conductor where permitted by CEC. Provide insulated equipment grounding conductor where indicated or required, including but not limited to:
    a. In each nonmetallic feeder and branch circuit raceway.
    b. In each flexible conduit.
    c. In outdoor portions of each metallic feeder and branch circuit raceway utilizing non-threaded fittings (where permitted) supplying rooftop multimotor and combination-load air-conditioning and refrigerating equipment.
4. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with CEC.
5. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
6. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
7. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
8. Provide bonding for interior metal piping systems in accordance with CEC. 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.
9. Provide bonding for interior metal air ducts.
10. Provide bonding for metal building frame.
11. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
12. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with CEC.
13. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with CEC and NFPA 99.

K. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

L. 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 CEC.
   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.
      d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

M. Signal Reference Grids:
   1. Provide signal reference grid on subfloor under access floors where indicated.
   2. Construct grid using field-welded sections of pre-fabricated signal reference grids.
   3. Unless otherwise indicated, locate grid between 6 and 18 inches (150 and 450 mm) from perimeter walls.
   4. Unless otherwise indicated, make bonding connections to signal reference grid using exothermic welded connections.
   5. Make bonding connections as short as possible, with no sharp folds or bends.
   6. Unless otherwise indicated, provide separate bonding connections from signal reference grid to each item to be bonded. Do not daisy chain items together to facilitate single point connection to signal reference grid.
   7. Provide 6 AWG bonding jumper to connect every sixth access floor pedestal in each direction to signal reference grid. Make connections to floor pedestals using exothermic welded connections.
   8. Provide 6 AWG bonding jumper to connect each steel column within and at the perimeter of room to signal reference grid. Make connections to steel columns using exothermic welded connections.
   9. Provide 6 AWG bonding jumper to connect each metal item such as conduits, pipes, ducts, etc. crossing the plane of, or within 6 feet (1.8 m) of, the signal reference grid. Make connections to conduits and pipes using listed ground clamps.
   10. Provide 6 AWG bonding jumper to connect signal reference grid to grounding point of separately derived systems serving equipment located on the signal reference grid.
   11. Provide low impedance risers to connect each equipment enclosure to signal reference grid. For each piece of equipment, provide two separate connections of different lengths connected to opposite sides of equipment and to different points on the signal reference grid. Make connections to equipment enclosures using mechanical connectors. Do not make connection to signal reference grid on the outermost grid conductor.

12. Provide transient suppression plates on floor beneath items indicated. Provide 6 AWG bonding jumper to connect transient suppression plate to signal reference grid.
    a. Transient Suppression Plates: Constructed from 26 gauge sheet copper, 4 by 4 feet unless otherwise indicated.

N. Lightning Protection Systems, in Addition to Requirements of Section 26 41 13:
1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with CEC and NFPA 780.

O. Cable Tray Systems: Also comply with Section 26 05 36.

P. Photovoltaic Systems: Also comply with Section 26 31 00.

Q. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

R. Static Control Flooring: Provide bonding of static control flooring provided in accordance with Section 09 65 00.

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 26 05 26:
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).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    a. Exceptions:
        1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors for accessible connections.

a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.

4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
b. Burndy LLC; [_____]: www.burndy.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
e. Or approved equal.
f. Substitutions: See Section 01 60 00 - Product Requirements.

5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC; [_____]: www.burndy.com/#sle.
b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
e. Or approved equal.
f. Substitutions: See Section 01 60 00 - Product Requirements.

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.
4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
5. Manufacturers:
a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
d. Harger Lightning & Grounding: www.harger.com/#sle.

e. Or approved equal.
f. Substitutions: See Section 01 60 00 - Product Requirements.

F. Chemically-Enhanced Ground Electrodes:
1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
2. Length: 10 feet.
3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.
5. Manufacturers:
a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
e. Or approved equal.
f. Substitutions: See Section 01 60 00 - Product Requirements.

G. Ground Plate Electrodes:
1. Material: Copper.
2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.
3. Manufacturers:
a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
e. Or approved equal.
f. Substitutions: See Section 01 60 00 - Product Requirements.

H. Ground Enhancement Material:
1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
2. Resistivity: Not more than 20 ohm-cm in final installed form.
3. Manufacturers:
a. Erico International Corporation: www.erico.com/#sle.
b. Harger Lightning & Grounding: www.harger.com/#sle.
c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

I. 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.
   a. Areas Exposed to Vehicular Traffic: Rated for not less than [_____] pounds vertical design load.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
   a. Round Wells: Not less than 8 inches in diameter.
   b. Rectangular Wells: Not less than 12 by 12 inches.
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".
5. Manufacturers:
   a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
   b. Erico International Corporation: www.erico.com/#sle.
   c. Harger Lightning & Grounding: www.harger.com/#sle.
   d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
   e. Substitutions: See Section 01 60 00 - Product Requirements.

J. Pre-Fabricated Signal Reference Grids:
1. Description: Factory pre-fabricated grid manufactured from 2 inch wide, 26 gauge, flat copper strips spaced on 24 inch centers, factory-welded at each crossover.
2. Low Impedance Risers: Factory fabricated 2 inch wide, 26 gauge, flat copper strips designed for connecting equipment enclosures to pre-fabricated signal reference grid.
3. Manufacturers:
   a. Advanced Lightning Technology (ALT); [_____]: www.altfab.com/#sle.
   b. Erico International Corporation: www.erico.com/#sle.
   c. Harger Lightning & Grounding: www.harger.com/#sle.
   d. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC; [_____]: www.thermoweld.com/#sle.
   e. Or approved equal.
   f. Substitutions: See Section 01 60 00 - Product Requirements.

K. Oxide Inhibiting Compound: Comply with Section 26 05 19.

2.03 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.

B. Framatome Connectors International: www.fciconnect.com.

C. Or approved equal.[____].

D. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ELECTRODES

A. Manufacturers:
1. Cooper Power Systems: www.cooperpower.com.

2. Framatome Connectors International: www.fciconnect.com.
3. Or approved equal.[____].
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Rod Electrodes: Copper.
1. Diameter: 3/4 inch.
2. Length: 10 feet.

C. Foundation Electrodes: 3/0 AWG. unless noted on plan.

2.05 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.

B. Exothermic Connections:

C. Wire: Stranded copper.

D. Grounding Electrode Conductor: Size to meet CEC requirements.

E. Grounding Well:
1. Well Pipe: 8 inch by 24 inch long clay tile pipe with belled end.
2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

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.

D. Verify existing conditions prior to beginning work.

E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Electrodes: Provide a grounding electrode system in the main electrical room/space of each building as follows:
1. Provide a 2-inch x 1/4-inch copper ground bar. Length shall be a minimum of 12 inches but longer as required for the number of connections made to the bar. This bar shall serve as the connection point for all grounding electrodes in the building. Install the copper ground bar in a NEMA 1 screw cover cabinet, minimum size 18 inches x 12 inches x 6 inches.
2. Connect the copper ground bar to the underground metal pipe (other than gas).
a. Connect to metal pipe with approved pipe clamp near the pressure reducing valve.
b. Connect to ground bar with exothermic weld.
c. Connect to metal pipe with copper clamp where copper water pipe occurs and with a malleable iron clamp where cast iron pipe occurs.

d. Install grounding conductor, sized as indicated on plans, in a 3/4-inch metal conduit from the ground cabinet to the water pipe. Provide grounding bushings at each end of the conduit.

3. Connect the copper ground bar to the metal frame of the building.
   a. At all steel framed buildings, provide a connection to the closest column.
   b. Connect to column with exothermic weld.
   c. Connect to the ground bar with exothermic weld or bolted-type connector.
   d. Install grounding conductor, sized as indicated on the plans, in a 3/4-inch metal conduit from the ground cabinet to the column. Provide grounding bushing at each end of the conduit.
4. Connect the copper ground bar to a concrete-encased electrode/Ufer.
   a. Install a minimum of 20 feet of #3/0 AWG conductor (minimum unless noted otherwise) encased in a minimum of 3 inches of concrete. Provide a non-metallic protective sleeve, minimum 6 inches long (3 inches in the concrete and 3 inches out of the concrete), located where the conductor exits the concrete.
   b. Install a #3/0 conductor from the ground bar to the concrete-encased electrode in a 3/4-inch metal conduit with grounding bushings. Make connections to the concrete-encased electrode with a bolted-type connector and transition from the metal conduit and non-metallic sleeve.
   c. Connect to the ground bar with exothermic weld or bolted-type connector.
5. Provide additional ground rod or concrete-encased electrodes as required to meet the performance requirements listed in these specifications at the ground bar.
   a. Install additional ground rods a minimum of 5 feet from any other rod.
   b. Notify the Owner’s Representative if performance requirements have not been met after installing 2 additional ground rods or concrete-encased electrodes.
6. Install other grounding electrodes as indicated on the single line diagram and other Contract Documents.

D. Grounding Electrode Conductor
1. Install grounding electrode conductor from the main normal and emergency power panels and each separately derived system in the building to the ground bar (grounding electrode system). Install grounding electrode conductor in steel conduit and bond grounding conductor to conduit at entrance and exit. Connect to the ground bar (grounding electrode system) with exothermic weld.
   a. Unless otherwise indicated, install main ground unspliced.
   b. Make connections easily accessible for inspection in ground bar cabinet.
2. Grounding electrode conductor shall be of the same type and quality as other conductors in the building.
3. The main neutral to ground bonding jumper will be located at the site utilities switchboard. Locate additional neutral to ground bonding jumper at

separately derived systems only, or at the main service panel when the building is served from a dedicated transformer. Neutral bar with all interior secondary neutrals shall be isolated from the common equipment grounding bus at all other locations.

E. Bonding
   1. Provide bonding to meet requirements of CEC.
   2. Bond together metal siding not attached to grounded structure, bond to ground.
   3. Bond prefabricated metal building to grounding electrode system at a minimum of one location.
   4. Bond together all metallic conduit, boxes, cabinets, and enclosures.

F. Grounding Conductors
   1. Provide grounding conductor for each branch circuit indicated.
   2. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder circuit raceway and within each motor feeder raceway. Terminate each end on suitable lug, bus, or bushing.
   3. Provide separate, isolated grounding conductor for each circuit which is installed (all or in part) in non-metallic conduit.
   4. Provide separate grounding conductor for circuits installed in flexible steel conduit. Terminate each end on a suitable lug, bus or bushing.
   5. Ground all conduit systems, cabinets, equipment, motor frames, etc., in accordance with CEC and applicable codes.

G. Grounding Connections
   1. Ground shields of shielded power cable and signal cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer.
   2. Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.
   3. Ground all fencing as shown on the grounding details on the Drawings.
   4. Bond neutrals of transformers within buildings to the system ground network, and to additional indicated grounding electrodes.
   5. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade.
   6. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground. Make connections of other grounding conductors generally accessible.
   7. In manhole pull boxes, install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.
   8. When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer’s recommendations. After welds have

been made and cooled, brush slag from the weld area and thoroughly clean the joint. Re-galvanize area if required. For compression connectors, use homogeneous copper, anti-corrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify the Owner's Representative prior to backfilling any ground connections.

9. Grounding pad plates shall be cast into the slab with the surface flush with the finished floor.

H. 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 CEC or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
   3. Provide ground well for future access to rod electrodes.

I. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

J. 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.

K. Identify grounding and bonding system components in accordance with Section 26 05 53.

L. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

M. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing . Bond steel together.

N. Provide bonding to meet requirements described in Quality Assurance.

O. Provide isolated grounding conductor for circuits supplying electronic cash registers.

P. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

Q. Interface with site grounding system installed under Section 33 7900.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Site Tests:
   1. Test under provisions of Section 26 08 13.
   2. Notify the Owner's Representative five days before inspection and testing.
   3. Use suitable test instruments to measure resistance to ground of systems. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
   4. Remove main bonding jumper at main service switchboard and at each separately derived system and test for infinite resistance between neutral and ground systems. Reconnect bonding jumper(s) after completion of testing.
   5. Record test results in accordance with Section 26 05 00 and submit.

E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 260526

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 26 05 36 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.

E. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

F. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

G. Section 26 25 13 - Low-Voltage Busways: Additional support and attachment requirements for busway.

H. Section 26 31 00 - Photovoltaic Collectors: Photovoltaic module mounting systems.

I. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

J. Section 26 51 33 - Luminaires, Ballasts, and Drivers - Lutron: Additional support and attachment requirements for luminaires.

K. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 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. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2018.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

F. MFMA-4 - Metal Framing Standards Publication 2004.

G. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.
H. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006
I. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010
J. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.
K. CEC – California Electrical Code.
L. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
M. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
N. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
D. Design Data
   1. Indicate hanger and support framing and attachment methods.
   2. Submit seismic zone 4 and structural calculations for proposed methods of support and attachment.

E. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.

F. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

G. Installer's Qualification Statement: Include evidence of compliance with specified requirements.

H. Product Data: Provide manufacturer’s catalog data for fastening systems.

I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of CEC.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

E. 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 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25%. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by CEC and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.

a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Components for Vibration Isolation and/or Seismic Controls: Comply with Section 26 05 48.

C. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.

D. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.
3. Manufacturers:
a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. HoldRite, a brand of Reliance Worldwide Corporation; [_____]: www.holdrite.com/#sle.
c. O-Z/Gedney, a brand of Emerson Electric Co; [_____]: www.emerson.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
e. Or approved equal
f. Substitutions: See Section 01 60 00 - Product Requirements.

E. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
1. Manufacturers:
a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. HoldRite, a brand of Reliance Worldwide Corporation; [_____]: www.holdrite.com/#sle.
d. O-Z/Gedney, a brand of Emerson Electric Co; [_____]: www.emerson.com/#sle.
e. Thomas & Betts Corporation: www.tnb.com/#sle.
f. Or approved equal.
g. Substitutions: See Section 01 60 00 - Product Requirements.

F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.

b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.
6. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Thomas & Betts Corporation: www.tnb.com/#sle.
   c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
   d. Or approved equal.
   e. Substitutions: See Section 01 60 00 - Product Requirements.
   f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

G. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Channel Material: Use polyester resin or vinyl ester resin.
2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
4. Manufacturers:
   a. Enduro Composites; [_____]: www.endurocomposites.com/#sle.
   b. Or approved equal.
   c. Substitutions: See Section 01 60 00 - Product Requirements.
   d. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

H. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Busway Supports: 1/2 inch diameter.
   c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
   d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
   e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
   f. Outlet Boxes: 1/4 inch diameter.
   g. Luminaires: 1/4 inch diameter.

I. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

4. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Erico International Corporation: www.erico.com/#sle.
    c. PHP Systems/Design: www.phpsd.com/#sle.
    d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
    e. Or approved equal.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

J. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
    a. Where approved by Electrical Engineer of Record.
11. Hammer-driven anchors and fasteners are not permitted.
    a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
    b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
    d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Or approved equal.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

15. Manufacturers - Powder-Actuated Fastening Systems:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Or approved equal.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MANUFACTURERS (LISTED IN ALPHABETICALLY ORDER ONLY AND NOT NECESSARY BY PREFERENCE)

A. Thomas & Betts Corporation: www.tnb.com.

B. Threaded Rod Company: www.threadedrod.com.

C. Or Approved Equal.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SUPPORTS

A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket.

B. Pipe racks for groups of parallel conduits shall be constructed of galvanized structural steel preformed channels of length as required, suspended on threaded rods and secured thereto with nuts above and below the cross bar.

C. Factory made pipe straps shall be one hole malleable iron or two hole galvanized clamps.

D. Supporting rods shall be at least 3/8" diameter and channel shall be at least 3/4" deep. Supporting hardware shall be galvanized steel.

2.04 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:
    1. Sheet Metal Screws: Steel
    2. Machine Screws Bolts, Nuts and Washers: Steel
    3. Precast Inserts: Suitable for the purpose.
    4. Anchor Bolts, expansion type (stainless steel).
        a. Phillips Red-Head
        b. Hilti Kwik-Bolt.
        c. WEJ-IT.
    5. Cast-in-Place Anchors: Suitable for the purpose (hot-dip galvanized except cadmium plated in dry locations)
    6. Beam Clamps: Steel.
    7. Detention Fasteners: In accordance with Section 11 19 23.

D. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
E. Steel Structural Elements: Use beam clamps or welded fasteners.
F. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
G. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
H. Solid Masonry Walls: Use expansion anchors or preset inserts.
I. Sheet Metal: Use sheet metal screws.
J. Wood Elements: Use wood screws.
K. Fastener Types:
    1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
    2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
    3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
    4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
    5. Other Types: As required.
    6. Manufacturers:
        a. Powers Fasteners, Inc: www.powers.com.
        b. Or approved equal.
L. Formed Steel Channel as indicated on drawings.
M. Powder-Actuated Anchors: As indicated on drawings
N. Steel Spring Clips: As indicated on drawings

PART 3 EXECUTION

3.01 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. General
    1. Install products in accordance with manufacturer's instructions.
    2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
    3. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
    1. Concrete – Precast inserts, cast-place anchors, or expansion type anchor bolts.
        a. When installing drilled-in anchors in non-prestresses reinforced concrete, avoid the reinforcing bars.

b. When installing drilled-in anchors into prestressed concrete (Pre- or Post-tensioned) locate tendons by using a non-destructive method prior to installation. Maintain a minimum clearance of one-inch between the reinforcement and the drilled-in anchor.

2. Sheet Metal – Sheet metal screws or machine bolts, nuts, and washers.
3. Structural Steel Members – Beam clamps, machine screws, bolts, nuts, and washers.

D. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.

F. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.

G. Field-Welding (where approved by LP Consulting Engineers, Inc.): Comply with Section 05 50 00.

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. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
6. Install surface mounted cabinets and panelboards with minimum of four anchors.
7. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 13/16-inch minimum off wall.
8. Use sheet metal channels to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
9. Support equipment in accordance with manufacturer’s instructions.
10. Verify that equipment will fit support layouts indicated.
    a. Where suitable equipment is used, revise indicated supports to fit at no additional cost.
11. Arrange for necessary openings to allow entry of equipment.
    a. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, or other devices to allow for later installation.

I. Conduit Support and Attachment
1. In damp or wet locations, space conduit support directly from concrete or metal structure out at least ¼ inch using straps with spacers or, if three (3)

or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of a channel.

2. Runs of individual conduit suspended from the floor or ceiling shall be supported with pipe hangers. Where three (3) or more conduits are suspended from the floor or ceiling, suitable racks shall be constructed from channel material with suitable fittings.
3. Space supporting points no greater than required by CEC.

J. Sleeves
   1. Set sleeves in position in formwork. Provide reinforcing around sleeves.
   2. Extend sleeves through floors 1 inch above finished floor levels. Caulk sleeves full depth and provide floor plate.
   3. Where raceway penetrated floor, ceiling, or wall. Close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal.

K. Cable Tray Support and Attachment: Also comply with Section 26 05 36.

L. Box Support and Attachment: Also comply with Section 26 05 33.16.

M. Busway Support and Attachment: Also comply with Section 26 25 13.

N. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.

O. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.

P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

Q. Secure fasteners according to manufacturer's recommended torque settings.

R. Remove temporary supports.

S. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with CEC.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.
   1. Obtain permission from the Architect and the Structural Engineer before drilling or cutting structural members.

E. All expansion anchors shall have 50 percent of the bolts (alternate bolts in any group arrangement) proof tested in tension and certified by a recognized testing agency. If there are any failures, the all bolts must then also be tested.

END OF SECTION 260529

SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Scope: Provide rigid metallic conduit, rigid non-metallic conduit, intermediate metal conduit, flexible metal conduit, electrical metallic tubing, surface metal and/or non-metallic raceways, cable tray and wireways as shown on the drawings and as described in the specifications.

1.02 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Intermediate metal conduit (IMC).
D. PVC-coated galvanized steel rigid metal conduit (RMC).
E. Flexible metal conduit (FMC).
F. Liquidtight flexible metal conduit (LFMC).
G. Electrical metallic tubing (EMT).
H. Rigid polyvinyl chloride (PVC) conduit.
I. Electrical nonmetallic tubing (ENT).
J. Liquidtight flexible nonmetallic conduit (LFNC).
K. Reinforced thermosetting resin conduit (RTRC).
L. Conduit fittings.
M. Accessories.
N. Conduit, fittings and conduit bodies.

1.03 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.
B. Section 07 84 00 - Firestopping.
C. Section 26 05 00 – Common Work Results for Electrical.
D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
E. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.
F. Section 26 05 29 - Hangers and Supports for Electrical Systems.
G. Section 26 05 33.16 - Boxes for Electrical Systems.
H. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
I. Section 26 0553 - Identification for Electrical Systems.

J. Section 26 05 39 - Underfloor Raceways for Electrical Systems.
K. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
L. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
M. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
N. Section 26 27 23 - Indoor Service Poles.
O. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems conduits.
P. Section 31 23 16 - Excavation.
Q. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
R. Section 31 23 23 - Fill: Bedding and backfilling.
S. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes.
T. The requirements of the kitchen equipment consultan plans and specifications.

1.04 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A) 2020.
D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit 2018.
E. CEC – California Electrical Code.
F. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.
H. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit 2004.
I. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
J. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
K. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
L. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
M. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
N. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT) 2014 (Reaffirmed 2019).
O. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series 2015.

P. NEMA TC 14.AG - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2021).

Q. NEMA TC 14.BG - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2020).

R. NEMA TC 14.XW - Extra Heavy Wall Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015.

S. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.

T. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.

U. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel Current Edition, Including All Revisions.

V. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.

W. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.

X. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.

Y. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.

Z. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

AA. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

BB. UL 1653 - Electrical Nonmetallic Tubing Current Edition, Including All Revisions.

CC. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit Current Edition, Including All Revisions.

DD. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings Current Edition, Including All Revisions.

EE. UL 2515 - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings Current Edition, Including All Revisions.

FF. UL 2515A - Standard for Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.06 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

E. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, fittings, and conduit bodies.

F. Project Record Documents: Accurately record actual routing of conduits larger than 1 1/4 inches.

1.07 QUALITY ASSURANCE

A. Conform to requirements of CEC.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.09 PROJECT CONDITIONS

A. Verify that field measurements are as shown on drawings.

B. Verify conduit routing and termination locations of conduits prior to rough in.

C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring systems.

1.10 RATED WALLS AND CEILINGS

A. Inspect architectural plans for locations and fire ratings for all walls, ceilings, and floors. Install materials as required to maintain the fire integrity of the rated assemblies.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by CEC and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit where emerging from underground.
   5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows or PVC-coated galvanized steel rigid metal conduit elbows for bends.
   6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
   7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
   1. Within Slab on Grade: Not permitted.

2. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit where emerging from concrete.
4. Where electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
1. Locations subject to physical damage include, but are not limited to:
a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
b. Where exposed below 20 feet in warehouse areas.
c. In Correctional Facilities, Galvanized rigid steel only for inmate accessible areas. Locations shall be verified with the architect.

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
1. Corrosive locations include, but are not limited to:
a. Cooling towers.

N. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.

O. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
1. Maximum Length: 6 feet.

P. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
   a. Transformers.
   b. Motors.
   c. Engine generators.

Q. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

R. Freezer and Refrigeration Rooms
1. Galvanized rigid steel conduit.
2. Use sealing fittings on refrigeration and freezer room conduit runs in accordance with CEC 300-7(a).

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with Section 26 21 00.

C. Communications Systems Conduits: Also comply with Section 27 10 00.

D. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.

E. Provide products listed, classified, and labeled as suitable for the purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 1/2 inch (16 mm) trade size.
2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
3. Control Circuits: 1/2 inch (16 mm) trade size.
4. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.
5. Underground, Interior: 1 inch (27 mm) trade size.
6. Underground, Exterior: 1 inch (27 mm) trade size.

G. Where conduit size is not indicated, size to comply with CEC but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
5. Or approved equal.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Manufacturers:
   a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
   b. Appleton.
   c. Crouse-Hinds.
   d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
   e. Thomas & Betts Corporation: www.tnb.com/#sle. (for reference, Thomas & Betts series numbers are listed in this section)
   f. Or approved equal.
   g. Substitutions: See Section 01 60 00 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Where an expansion type fitting is not required, use a coupling or “Erickson” type coupling as appropriate. Threadless set screw and compression (gland) type fittings are not permitted.
6. At building expansion joints, use expansion type fittings.
7. Make connections to NEMA 12 boxes with a threaded hub.

D. Locknuts
   1. Hardened Steel or malleable iron construction, electro zinc plated, capable of insuring positive bond to enclosure.
      a. Non-bonding: T & B Series 142 or approved equal.
      b. Bonding: T & B Series 107 or approved equal.

E. Bushings
   1. Insulted: T & B Series 223 or approved equal.
   2. Insulated Metallic Bushing: T & B Series 1223 or approved equal.
   3. Insulated Grounding and Bonding Bushing: T & B Series 3871 or approved equal.

F. Couplings
   1. Non-metallic Conduit Coupling: By non-metallic conduit manufacturer for the application.
   2. Threaded Rigid Metal Conduit Couplings: By conduit manufacturer for the application.
   3. Threadless Coupling: “Erickson” Type Y & B Series 676 or approved equal.
   4. Expansion Type: Permit ¾ inch movement any direction.
      a. Exposed: Weatherproof with external bonding jumper.
      b. Embedded: Watertight with internal bonding jumper.

G. Connectors
   1. Non-Metallic Conduit Connector: By conduit manufacturer for the application.

2. Threaded Hubs: Electro zinc coated with nylon insulated throat and ail/moisture resistant recessed sealing ring, raintight.
   a. Non-bonding: T & B Series 371 or approved equal.
   b. Bonding: T & B Series 371 with 107 series bonding locknut or approved equals.

H. Nipple: “Chase” Type, insulated: T & B Series 5263 or approved equal.

I. Sealing Gaskets: Oil and moisture resistant rubber bonded to metallic retainer.
   1. With rigid conduit – T & B Series 5303 or approved equal.
   2. Fittings not specifically listed but required shall be of similar style and quality.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
   2. Nucor Tubular Products: www.nucortubular.com/#sle.
   3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
   4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
   5. Or approved equal.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Or approved equal.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use aluminum.
   5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
   1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
   2. Nucor Tubular Products: www.nucortubular.com/#sle.
   3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.

4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
5. Or approved equal.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

D. Conduit Size: Comply with CEC.
1. Exposed: Use rigid steel conduit or intermediate metal conduit for installation up to 8 feet.

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

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedtube.com.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Robroy Industries: www.robroy.com/#sle.
4. Or Equal..
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, 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.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. Interior Coating: Urethane, minimum thickness of 2 mil.

E. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.

5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
6. Interior Coating: Urethane, minimum thickness of 2 mil.

F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

G. Description: NEMA RN 1; rigid steel conduit with external PVC coating.

H. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Or approved equal.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.

D. Description: Interlocked steel construction.

E. Connectors and Fittings: NEMA FB 1.
1. Flexible metal conduit connector – Insulated throat, suitable as grounding means: T & B Serries 3115.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Or approved equal.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Or approved equal.
    e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
    a. Do not use die cast zinc fittings.

D. Description: Interlocked steel construction with PVC jacket.

E. Fittings: NEMA FB 1.

2.09 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular/#sle.
3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
4. Beck Manufacturing, Inc: www.beckmfg.com.
5. Wheatland Tube Company: www.wheatland.com/#sle.
6. Or Equal.[____].
7. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Or approved equal.
    e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
    a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
    a. Do not use indenter type connectors and couplings.
    b. Do not use set-screw type connectors and couplings.
    c. EMT Coupling: Raintight T & B Series 5220 or approved equal.
    d. EMT to Rigid Metal Conduit Connector, Raintight: T & B Series 531 or approved equal.
5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

D. Description: ANSI C80.3; galvanized tubing.

E. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Cantex Inc: www.cantexinc.com/#sle.
2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
3. JM Eagle: www.jmeagle.com/#sle.
4. Or approved equal.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 NONMETALLIC TUBING (ENT)

A. Not permitted for use in this project, no exceptions.

B. Description: CEC, Type ENT electrical nonmetallic tubing complying with NEMA TC 13 and listed and labeled as complying with UL 1653.

2.12 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Or approved equal.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: CEC, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.13 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Manufacturers:
1. Champion Fiberglass, Inc; [_____]: www.championfiberglass.com.
2. FRE Composites; [_____]: www.frecompositesinc.com
3. United Fiberglass of America, Inc; [_____]: www.unitedfiberglass.com

4. Or approved equal.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Applications:
1. Above Ground, Not Subject to Physical Damage: Use aboveground (AG), SW (Standard Wall), HW (Heavy Wall), or XW (Extra Heavy Wall) RTRC.
2. Above Ground, Subject to Physical Damage: Use aboveground (AG), XW (Extra Heavy Wall) RTRC.
3. Underground, Direct-Buried: Use belowground (BG), DB (direct burial) RTRC or aboveground (AG) RTRC.
4. Underground, Embedded in Concrete: Use belowground (BG), EB (encased burial) RTRC, belowground (BG), DB (direct burial) RTRC, or aboveground (AG) RTRC.
5. Do not use RTRC in hazardous (classified) locations.

C. Description: CEC, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
1. Aboveground (AG) RTRC: Comply with NEMA TC 14.AG and list and label as complying with UL 2515.
2. Aboveground (AG), XW (Extra Heavy Wall) RTRC: Comply with NEMA TC 14.XW and list and label as complying with UL 2515A.

D. Supports: Per manufacturer's recommendations.

E. Fittings: Same type and manufacturer as conduit to be connected.
1. Cement-Tight Joints: Use bonded coupling or bell and spigot.
2. Cement- and Water-Tight Joints: Use adhesive and manufacturer's standard gaskets.

2.14 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
1. Internal to fittings
a. Approved by manufacturer for application.
2. Manufacturer
a. Crouse-Hinds Chico A-P and Chico X fiber.
b. O.Z. Gedney.
c. Or approved equal.

G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
   1. Products:
      a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
      b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
      c. Or approved equal.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

I. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
   1. Manufacturers:
      a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
      b. Or approved equal.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
   1. Products:
      a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
      b. Or approved equal.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

K. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
      b. Or approved equal.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

L. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
      b. Or approved equal.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

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.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

H. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

I. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.
      d. Across building exterior surfaces.
   6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   7. Arrange conduit to maintain adequate headroom, clearances, and access.
   8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   9. Arrange conduit to provide no more than 150 feet between pull points.

10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in the same area together on a common rack.

J. Conduit Support:
1. Secure and support conduits in accordance with CEC and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
10. Use of spring steel conduit clips for support of conduits is not permitted.
    a. Support of electrical metallic tubing (EMT) up to 1 inch (27 mm) trade size concealed above accessible ceilings and within hollow stud walls.
11. Use of wire for support of conduits is not permitted.
    a. For securing conduits to studs in hollow stud walls.
    b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).
12. Where conduit support intervals specified in CEC and NECA standards differ, comply with the most stringent requirements.

K. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

L. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

M. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 23 16 and Section 31 23 23.
2. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.

3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.

N. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
   1. Include proposed conduit arrangement with submittals.
   2. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.
   3. Minimum Conduit Spacing: As indicated on drawings.
   4. Install conduits within middle one third of slab thickness.
   5. Secure conduits to prevent floating or movement during pouring of concrete.

O. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

P. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with CEC.

Q. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where calculated in accordance with CEC for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
   3. Where calculated in accordance with CEC for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
   4. Where conduits are subject to earth movement by settlement or frost.

R. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
   3. Where conduits penetrate coolers or freezers.

S. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

T. Provide grounding and bonding in accordance with Section 26 05 26.

U. Identify conduits in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 EMPTY CONDUITS

A. Certain conduits will have no conductors pulled in as a part of this contract. Identify with tags at each end of the origin and destination of each such empty conduits. Provide a permanent cap over each end of each empty conduit. Provide a nylon pull wire in each empty conduit, tie off at both ends.

3.05 TESTING AND INSPECTION

A. So not cover up conduit work until inspected. Notify the Owner’s Representative at least 3 days before desired inspection date.

3.06 CLEANING

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

3.07 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

B. All conduuits shall be run concealed in walls and/or ceiling. Where conduits can not be run concealed in wall and/or ceiling space, the Constractor shall coordinate with the architectural and structural plans and the Architect for installing and routing of exposed conduits.

3.08 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

END OF SECTION 260534

SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Scope: Provide boxes, pull boxes, racks, and enclosures as shown on drawings or as required by code(s).

B. Section Includes:

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Boxes for hazardous (classified) locations.

E. Floor boxes.

F. Underground boxes/enclosures.

G. Accessories.

H. Wall and ceiling outlet boxes.

I. Floor boxes.

J. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 07 84 00 - Firestopping.

C. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

E. Section 26 05 29 - Hangers and Supports for Electrical Systems.

F. Section 26 05 33.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

G. Section 26 05 33.23 - Surface Raceways for Electrical Systems:
   1. Accessory boxes designed specifically for surface raceway systems.
   2. Lay-in wireways and wiring troughs with removable covers.

H. Section 26 05 39 - Underfloor Raceways for Electrical Systems: Junction boxes for underfloor duct systems.

I. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

J. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

K. Section 26 27 26 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.

3. Poke-through assemblies.
4. Access floor boxes.
5. Additional requirements for locating boxes for wiring devices.

L. Section 26 28 13 - Fuses: Spare fuse cabinets.

M. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.

N. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

O. Section 26 2716 - Electrical Cabinets and Enclosures.

P. Section 26 2726 - Wiring Devices: Wall plates in finished areas.

Q. The requirements of the kitchen equipment consultan plans and specifications.

1.03 REFERENCE STANDARDS

A. CEC – California Electrical Code.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

F. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).

G. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports 2013 (Reaffirmed 2020).

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

I. SCTE 77 - Specifications for Underground Enclosure Integrity 2017.

J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

L. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.

M. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

N. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers 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.

1.04 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 CEC.

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 CEC.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to CEC.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

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

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
   1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.

C. Samples:
   1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

F. Maintenance Materials: Furnish the following for TRUSD's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of CEC.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by CEC 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 CEC but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   6. Use suitable concrete type boxes where flush-mounted in concrete.
   7. Use suitable masonry type boxes where flush-mounted in masonry walls.
   8. Use raised covers suitable for the type of wall construction and device configuration where required.
   9. Use shallow boxes where required by the type of wall construction.
   10. Do not use "through-wall" boxes designed for access from both sides of wall.
   11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
16. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
    c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
17. Wall Plates: Comply with Section 26 27 26.
18. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
    c. Hubbell Incorporated; RACO Products; [_____]: www.hubbell-rtb.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co; [_____]: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.
    f. Or equal.
    g. Substitutions: See Section 01 60 00 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
    c. Kitchens and food prep. Locations: Type 4X, stainless steel, unpainted.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:

a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
d. Or equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
1. Manufacturers:
a. Hubbell Incorporated; [_____]: www.hubbell.com/#sle.
b. Or approved equal.
c. Substitutions: See Section 01 60 00 - Product Requirements.

E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
a. Appleton, a brand of Emerson Electric Co; [_____]: www.emerson.com/#sle.
b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.
d. Or approved equal.
e. Substitutions: See Section 01 60 00 - Product Requirements.

F. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

G. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:

a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.

6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
   a. Manufacturers:
      1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
      2) MacLean Highline: www.macleanhighline.com/#sle.
      3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
      4) Or equal.
      5) Substitutions: See Section 01 60 00 - Product Requirements.
   b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
   c. Product(s):
      1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
         (a) 11 by 18 by 12 inches nominal; Model PHA111812 (stackable).
      2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
         (a) 11 by 18 by 12 inches nominal; Model CHA111812.
      3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.
         (a) 30 by 48 by 18 inches nominal; Model CVA304818.
      4) Or approved equal.

2.02 ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
   1. Manufacturers:
      a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
      b. Or approved equal.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MANUFACTURERS

A. Appleton Electric: www.appletonelec.com.
B. Arc-Co./Division of Arcade Technology; Model [_____]: www.arc-co.com.
C. Unity Manufacturing: www.unitymfg.com.

D. Or approved equal.

E. Substitutions: See Section 01 6000 - Product Requirements.

2.04 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: As specified in Section 26 2726.

2.05 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.

B. Material: Cast metal.

C. Shape: Round.

D. Service Fittings: As specified in Section 26 2726.

2.06 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 26 2716.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
   1. Material: Galvanized cast iron.
   2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
   3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Boxes are indicated in approximate locations only on the drawings unless specifically dimensioned. Verify all box locations prior to rough-in.

C. Verify that mounting surfaces are ready to receive boxes.

D. Verify that conditions are satisfactory for installation prior to starting work.

E. Verify locations of floor boxes and outlets prior to rough-in.

F. Verify locations of all boxes required for kitchen equipment with kithcen consultant plans and specifications.

3.02 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 CEC.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
      b. Communications Systems Outlets: Comply with Section 27 10 00.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
      b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
   10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.

11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:
    1. Secure and support boxes in accordance with CEC and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
    2. Provide required seismic controls in accordance with Section 26 05 48.
    3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with CEC. Do not provide support from piping, ductwork, or other systems.
    4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
    5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
    1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
    2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
    3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.

M. Install boxes as required to preserve insulation integrity.

N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

P. Underground Boxes/Enclosures:
    1. Install enclosure on gravel base, minimum 6 inches deep.
    2. Flush-mount enclosures located in concrete or paved areas.
    3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
    4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.

5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

Q. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

S. Close unused box openings.

T. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

U. Provide grounding and bonding in accordance with Section 26 05 26.

V. Identify boxes in accordance with Section 26 05 53.

W. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

X. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 72.

Y. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.

Z. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

AA. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

BB. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

CC. Maintain headroom and present neat mechanical appearance.

DD. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

EE. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

FF. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

GG. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

HH. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

II. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

JJ. Use flush mounting outlet box in finished areas.

KK. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

LL. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in fire-rated and acoustic rated walls.

MM. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

NN. Use stamped steel bridges to fasten flush mounting outlet box between studs.

OO. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

PP. Use adjustable steel channel fasteners for hung ceiling outlet box.

QQ. Do not fasten boxes to ceiling support wires.

RR. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

SS. Use gang box where more than one device is mounted together. Do not use sectional box.

TT. Use gang box with plaster ring for single device outlets.

UU. Use cast outlet box in exterior locations exposed to the weather and wet locations.

VV. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

WW. Set floor boxes level.

XX. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.04 CLEANING

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

3.05 PROTECTION

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

END OF SECTION 260537

SECTION 26 05 53

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. Floor marking tape.
G. Warning signs and labels.
H. Field-painted identification of conduit.

1.02 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.
B. Section 09 91 23 - Interior Painting.
C. Section 26 05 00 – Common Work Results for Electrical.
D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
E. Section 26 05 36 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
F. Section 26 05 73 - Power System Studies: Arc flash hazard warning labels.
G. Section 26 23 00 - Low-Voltage Switchgear: Factory-installed mimic bus.
H. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
I. Section 26 31 00 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
J. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

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. CEC – California Electrical Code.
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. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Samples:
   1. Identification Nameplates: One of each type and color specified.
   2. Warning Signs and Labels: One of each type and legend specified.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of CEC.

B. Conform to requirements of CEC.

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. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify main and tie devices.
         5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Switchboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify main overcurrent protective device.
         5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

c. Motor Control Centers:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify power source and circuit number. Include location when not within sight of equipment.
   4) Use identification nameplate to identify main overcurrent protective device.
   5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
d. Panelboards:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify power source and circuit number. Include location when not within sight of equipment.
   4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
   5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
   6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
e. Transformers:
   1) Identify kVA rating.
   2) Identify voltage and phase for primary and secondary.
   3) Identify power source and circuit number. Include location when not within sight of equipment.
   4) Identify load(s) served. Include location when not within sight of equipment.
f. Enclosed switches, circuit breakers, and motor controllers:
   1) Identify voltage and phase.
   2) Identify power source and circuit number. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location when not within sight of equipment.
g. Busway:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify power source and circuit number. Include location when not within sight of equipment.
   4) Provide identification at maximum intervals of 40 feet.
   5) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.
h. Time Switches:
   1) Identify load(s) served and associated circuits controlled. Include location.
i. Enclosed Contactors:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
   4) Identify coil voltage.

5) Identify load(s) and associated circuits controlled. Include location.

j. Centralized Emergency Lighting Inverters:
   1) Identify input and output voltage and phase.
   2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location.

k. Transfer Switches:
   1) Identify voltage and phase.
   2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location when not within sight of equipment.
   4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

l. Electricity Meters:
   1) Identify load(s) metered.

2. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.
   b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Emergency System Equipment:
   a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with CEC.
   b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
   c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with CEC.
6. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with CEC.
7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
8. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
9. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
10. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
    a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 91 23 and 09 91 13.

12. Available Fault Current Documentation: Comply with Section 26 05 73. Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by CEC 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.
13. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
14. 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 CECE for minimum PPE requirements" or approved equivalent.
    c. Service Equipment: Include the following information in accordance with CEC.
        1) Nominal system voltage.
        2) Available fault current.
        3) Clearing time of service overcurrent protective device(s).
        4) Date label applied.
15. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
16. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
17. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
18. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:
    1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
    2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.
    3. 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.

4. 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 when more than one circuit is present.
    c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
    d. In cable tray, at maximum intervals of 20 feet.
5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
6. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
    a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
        1) Color Code:
            (a) Emergency Power System: Red.
                (1) Life Safety Branch: White.
                (2) Critical Branch: Yellow.
                (3) Equipment Branch: Green.
            (b) Fire Alarm System: Red.
        2) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
        3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
        4) Other Owner required color coding systems.
3. 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.
4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
5. Use underground warning tape to identify underground raceways.
6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

E. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 10 00.
2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
4. 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.

G. Buried Electrical Lines: Underground warning tapes.

H. Communication Cabinets: Nameplates.

I. Conduit: Conduit markers.

J. Control Device Station: Labels.

K. Electrical Distribution and Control Equipment Enclosures: Nameplates.

2.02 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Seton Identification Products: www.seton.com/aec.

C. HellermannTyton: www.hellermanntyton.com.

D. Or equal.

E. Substitutions: See Section 01 6000 - Product Requirements.

2.03 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.
      a. Use only for indoor locations.
   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.
   5. Color:
      a. Normal Power System: White text on black background.
      b. Emergency Power System: White text on red background.
      c. Fire Alarm System: White text on red 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.
a. Include voltage and phase for other than 120 V, single phase circuits.
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.

G. Manufacturers:
1. Kolbi Pipe Marker Co.; Model: www.kolbipipemarkers.com.
2. Seton Identification Products; Model: www.seton.com.
3. Or Equal..

H. Nameplates: Engraved three-layer laminated plastic, white letters on black background.

I. Locations:
1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.

J. Letter Size:
1. Use 1/8 inch letters for identifying individual equipment and loads.
2. Use 1/4 inch letters for identifying grouped equipment and loads.

K. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.04 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Seton Identification Products: www.seton.com.
3. HellermannTyton: www.hellermanntyton.com/#sle.
4. Or Equal..

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, or plastic sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

H. Description: Vinyl cloth type self-adhesive wire markers.

I. Description: Cloth type wire markers.

J. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

K. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.05 VOLTAGE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Seton Identification Products: www.seton.com/#sle.
   3. HellermannTyton: www.hellermanntyton.com.
   4. Or Equal..

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
   2. Markers for System Identification:
      a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

G. Location: Furnish markers for each conduit longer than 6 feet.

H. Spacing: 20 feet on center.

I. Color:
   1. Fire Alarm System: Red.

2.06 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Seton Identification Products: www.seton.com/#sle.
   3. HellermannTyton: www.hellermanntyton.com.
   4. Or Equal..

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:

1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.07 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.08 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. 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.
      a. Do not use labels designed to be completed using handwritten text.
   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.

D. Description: 3 inch wide polyethylene tape, detectable type colored red with suitable warning legend describing buried electrical lines.

E. Description: 4 inch wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 PREPARATION

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

B. Degrease and clean surfaces to receive nameplates and labels.

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.
   1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.

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. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

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

END OF SECTION 260553

SECTION 26 22 10

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The requirements of this section are in addition to the requirements of Division 1, General Conditions and Supplementary Conditions.

B. The requirements of Veneklassen Associates specification Section 01 - Electrical Equipment Noise Control-Vibration Isolation and Seismic Restraints.

1.02 SUMMARY

A. Scope: Provide Dry type transformers as shown on the Drawings.

1.03 QUALITY ASSURANCE

A. Transformers shall be designed, manufactured and tested in accordance with all the latest applicable ANSI, NEMA and IEEE standards, and shall be listed by Underwriters Laboratories and bear the UL label.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI C57.96.

1.04 QUALIFICATIONS

A. The equipment manufacturer shall be ISO 9000, 9001 or 9002 certified.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

C. The transformers shall be suitable for and certified to meet all applicable seismic requirements of California Building Code (CBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the transformer manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 0.75g, and a ZPA of 0.38g. The tests shall fully envelope this response spectrum for all equipment natural frequencies up to at least 35 Hz.

D. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response.

1.05 SUBMITTALS

A. Submit manufacturers data and shop drawings in accordance with Section 16010 for items listed.
   1. Manufacturers Data Sheets
   2. Outline dimension and weights
   3. Technical certification sheet
   4. Conduit entry/exit locations
   5. Transformer ratings including:
      a. kVA
      b. Primary and secondary Voltage
      c. Taps
      d. Basic Impulse level (BIL) for equipment over 600-volts
      e. Design Impedance
      f. Insulation class and temperature rise
      g. Sound level

PART 2 PRODUCTS

2.01 MATERIAL

A. Transformer shall be convection cooled that comply with NEMA Standard TP1 with ratings (kVA) and voltages as indicated on the drawings. Provide NEMA 1 (indoor) or NEMA 3R with weathershields (outdoor) enclosed units designed specifically for energy efficient operation and bear the “Energy Star” label and not greater that 80 degree C. temperature rise over 40 degree C. ambient. Enclosure temperature rise may not exceed 35 degree C. over 40 degree C. ambient. Enclosures shall include insect screens. Enclosures shall be modified or protected, as required, to make them safe for installation on school grounds.

B. Manufacturer shall guarantee that sound level will not exceed NEMA standard for the KVA rating of the transformer. Applicable NEMA standards are as follows:
   1. KVANEMA Average
      a. Sound Level
      b. 0 - 940 dB
      c. 10 - 5045 dB
      d. 51 - 15050 dB
      e. 151 - 30055 dB
      f. 301 - 50060 dB
      g. 501 - 70062 dB
      h. 701 - 100064 dB
      i. 1001 - 150065 dB

C. The windings shall be separate primary and secondary coils factory connected in Delta primary and grounded WYE secondary configuration. A secondary

system grounding lug shall be provided prewired to WYE "neutral" and transformer enclosure.

D. Primary taps shall be full capacity, with a minimum of two 2-1/2% above and below rated voltage.
   1. Weather exposed “3 & 3R” rated transformer shall have weather shield and enclosures shall have all metal surfaces painted with dry powder polyurethane plastic, electrostatically applied to produce a minimum finish of three (3) mils thick. The coated metal shall be baked at a temperature of 4000 degrees Fahrenheit for a period of no less than 20 minutes.
   2. The transformers shall be manufactured by Cutler-Hammer series. Only transformers by Square-D series will be accepted as equals.

E. Provide vibration isolating mounts to isolate the enclosure from the core and coil assembly.

F. Mounting, suitable as listed:
   1. Three Phase Transformers, through 15 kvA: Wall
   2. Three Phase Transformers, 15 kvA and above: Floor or ceiling hung channel.

G. Connect a grounding strap from the secondary neutral to a grounding lug on the enclosure.

2.02 MANUFACTURER

A. Square D is the basis of design; manufacturer is existing on campus.

B. Or equivalent subject to substitution process.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
   1. Ratio tests at the rated voltage connection and at all tap connections.
   2. Polarity and phase relation tests on the rated voltage connection.
   3. Applied potential tests.
   4. Induced potential test.
   5. No-load and excitation current at rated voltage on the rated voltage connection.

3.02 INSTALLATION

A. Transformers shall be installed in accordance with manufacturer's instructions and the requirements of the California Electrical Code (CEC). Verify clearances required and CEC ventilation requirements. Enclosures shall be modified or protected, as required, to make them safe for installation on school grounds. Terminations and all exposed portions of current carrying conductors shall be covered with heavy wall heat shrink tubing. Use an electric heat gun to shrink tubing. Install bug screens and weatherproof kits on all transformers not installed in buildings.

B. Secure wall mounted transformers to building structure with not less than four 5/8" bolts or screws and flat washers as required and/or as shown on plans.

C. Provide one (1) vibration isolating mount, minimum 1 inch thick with 1 inch static deflection, for each mounting point on the transformer.

D. Connect transformer with flexible metal conduit. Provide an insulated grounding bushing on conduit and bond to transformer case.

E. Provide house cleaning concrete pad for all floor mounted transformer. Secure floor mounted transformers to concrete pad with not less than four 5/8" galvanized machine bolts and flat washers as required. Concrete anchors shall be HILTI heavy duty "HSL" series with 3-1/2" embedment and/or as shown on plans.

F. Final locations of all transformers shall be verified with the project Architect for acceptance prior to installation of conduit. Transformers and their associated concrete pads shall be installed in locations outside of designated pedestrian circulation (i.e. sidewalks, corridors, path ways, etc.); and where the sound rating or the transformer will not interfere with building interior functionality and tasks.

G. Install grounding electrode conductor, shown on the Drawings, for separately derived system to all available grounding electrodes, i.e., building service equipment, grounding conductor, building steel, cold water pipe, as applicable. A single connection to a new or existing "made electrode" isolated from the building service equipment ground will not be acceptable.

3.03 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.04 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION 262210

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260553 - Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

A. CEC – California Electrical Code.

B. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.

C. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2000 (R2005).

D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001 (R2006).

E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2006.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2007.

G. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

D. Maintenance Materials: Furnish the following for District (Owner)'s use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Panelboard Keys: Two of each different key.

1.05 QUALITY ASSURANCE

A. Conform to requirements of CEC.

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. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
Schneider Electric; Square D Products: Detail has been deleted as condition does not occur on particular campus."

B.

C. Siemens

D. Or equivalent subject to substitution process

2.02 POWER DISTRIBUTION PANELBOARDS

A. Description: NEMA PB 1, circuit breaker type.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

C. Minimum integrated short circuit rating: As indicated.
   1. 240 Volt Panelboards: amperes rms symmetrical per plan.
   2. 480 Volt Panelboards: amperes rms symmetrical per plan.

D. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.

E. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay.
   1. Coil operating voltage: 120 volts, 60 Hz.
   2. Size as shown on Drawings.

F. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

G. Enclosure: NEMA PB 1, Type 1, cabinet box.

H. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

C. Minimum Integrated Short Circuit Rating: As indicated.
   1. 240 Volt Panelboards: 10,000 amperes rms symmetrical.
   2. 480 Volt Panelboards: 14,000 amperes rms symmetrical.

D. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
   1. Type SWD for lighting circuits.
   2. Type HACR for air conditioning equipment circuits.
   3. Class A ground fault interrupter circuit breakers where scheduled.
   4. Do not use tandem circuit breakers.

E. Enclosure: NEMA PB 1, Type 1.

F. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.

G. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

D. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

E. Provide engraved plastic nameplates under the provisions of Section 260553.

F. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
   1. Minimum spare conduits: 5 empty 1 inch.

G. Ground and bond panelboard enclosure according to Section 260526.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.03 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 262416

SECTION 26 27 17

EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 260534 - Conduit.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).

C. Section 260537 - Boxes.

D. Section 262726 - Wiring Devices.

1.03 REFERENCE STANDARDS

A. CEC – California Electrical Code.

B. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).

C. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
2. Determine connection locations and requirements.

B. Sequencing:

1. Install rough-in of electrical connections before installation of equipment is required.
2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.06 QUALITY ASSURANCE

A. Conform to requirements of CEC.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Conform to NEMA WD 1.

2. Cord Construction: CEC, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As described and in individual equipment sections.

C. Wiring Devices: As specified in Section 262726.

D. Flexible Conduit: As specified in Section 260534.

E. Wire and Cable: As specified in Section 260519.

F. Boxes: As specified in Section 260537.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION 262717

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.
B. Wall dimmers.
C. Fan speed controllers.
D. Receptacles.
E. Wall plates.
F. Floor box service fittings.
G. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260537 - Boxes.
C. Section 260553 - Identification for Electrical Systems: Labels for wiring devices.
D. Section 262717 - Equipment Wiring: Cords and plugs for equipment.
E. Section 262723 - Indoor Service Poles.
F. Section 271005 - Structured Telecommunications Cabling and Enclosures: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. CEC – California Electrical Code.
B. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
C. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
D. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
E. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
F. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

L. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.04 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. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   6. Notify the Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. 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. Conform to requirements of CEC.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pass & Seymore

B. Cooper Wiring Devices: www.cooperwiringdevices.com.

C. Leviton Manufacturing, Inc: www.leviton.com.

D. Or equal.

E. APPLICATIONS

2.02 PROVIDE WIRING DEVICES SUITABLE FOR INTENDED USE AND WITH RATINGS ADEQUATE FOR LOAD SERVED.

A. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

B. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.

C. Provide GFI receptacles for all receptacles installed within 6 feet of sinks.

D. Provide GFI receptacles for all receptacles installed in kitchens.

E. Provide GFI receptacles for all receptacles serving electric drinking fountains.

F. Provide isolated ground receptacles for all receptacles serving computers and electronic cash registers.

G. Unless noted otherwise, do not use combination switch/receptacle devices.

H. For flush floor service fittings, use tile rings for installations in tile floors.

I. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

J. ALL WIRING DEVICES

2.03 PROVIDE PRODUCTS LISTED AND CLASSIFIED BY UNDERWRITERS LABORATORIES INC. AS SUITABLE FOR THE PURPOSE SPECIFIED AND INDICATED.

A. Finishes:

2.04 ALL WIRING DEVICES: WHITE WITH WHITE NYLON WALL PLATE UNLESS OTHERWISE INDICATED.

A. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate unless otherwise indicated.

B. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate unless otherwise indicated.

C. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover unless otherwise indicated.

D. Isolated Ground Convenience Receptacles: Orange with isolated ground triangle mark on device face.

E. Surge Protection Receptacles: Blue.

F. Clock Hanger Receptacles: White with nylon wall plate.

G. Above-Floor Service Fittings: wiring devices with housing.

H. Flush Floor Box Service Fittings: wiring devices with cover and ring/flange.

I. Flush Poke-Through Service Fittings: wiring devices with cover and aluminum flange.

J. WALL SWITCHES

2.05 ALL WALL SWITCHES: AC ONLY, QUIET OPERATING, GENERAL-USE SNAP SWITCHES WITH SILVER ALLOY CONTACTS, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 20 AND WHERE APPLICABLE, FS W-S-896; TYPES AS INDICATED ON THE DRAWINGS.

2.06 WIRING PROVISIONS: TERMINAL SCREWS FOR SIDE WIRING AND SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW.

2.07 PILOT LIGHT WALL SWITCHES: INDUSTRIAL SPECIFICATION GRADE, 20 A, 120/277 V WITH RED ILLUMINATED STANDARD TOGGLE TYPE SWITCH ACTUATOR AND MAINTAINED CONTACTS; ILLUMINATED WITH LOAD ON; SINGLE POLE SINGLE THROW, DOUBLE POLE SINGLE THROW, THREE WAY, OR FOUR WAY AS INDICATED ON THE DRAWINGS.

A. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; all switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

B. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.

C. Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; all switches keyed alike; single pole double throw, off with switch actuator in center position.

D. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.

2.08 BODY AND HANDLE: WHITE PLASTIC WITH TOGGLE HANDLE.

A. Indicator Light: Lighted handle type switch; red handle.

B. Locator Light: Lighted handle type switch; red color handle.

C. Ratings:

D. Voltage: 120 and 277 volts, AC.

2.09 CURRENT: 20 AMPERES.

2.10 SWITCH TYPES: SINGLE POLE, DOUBLE POLE, AND 3-WAY.

A. WALL DIMMERS

2.11 ALL WALL DIMMERS: SOLID-STATE WITH CONTINUOUS FULL-RANGE EVEN CONTROL FOLLOWING SQUARE LAW DIMMING CURVE, INTEGRAL RADIO FREQUENCY INTERFERENCE FILTERING, POWER FAILURE PRESET MEMORY, AIR GAP SWITCH ACCESSIBLE WITHOUT REMOVING WALL PLATE, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 1472; TYPES AND RATINGS SUITABLE FOR LOAD CONTROLLED AS INDICATED ON THE DRAWINGS.

A. Electronic Low-Voltage Wall Dimmers: 120 V AC, slide control type with separate on/off switch; single pole or three way as indicated on the drawings.

2.12 POWER RATING: 400 VA UNLESS OTHERWISE INDICATED OR REQUIRED TO CONTROL THE LOAD INDICATED ON THE DRAWINGS.

2.13 FLUORESCENT WALL DIMMERS: 120 V AC, SLIDE CONTROL TYPE WITH SEPARATE ON/OFF SWITCH, COMPATIBLE WITH DIMMING BALLAST CONTROLLED; SINGLE POLE OR THREE WAY AS INDICATED ON THE DRAWINGS.

2.14 POWER RATING: 600 VA UNLESS OTHERWISE INDICATED OR REQUIRED TO CONTROL THE LOAD INDICATED ON THE DRAWINGS.

2.15 WALL DIMMERS: SEMICONDUCTOR DIMMER FOR INCANDESCENT LAMPS, TYPE AS INDICATED ON DRAWINGS, COMPLYING WITH NEMA WD 6 AND WD 1.

2.16 BODY AND HANDLE: WHITE PLASTIC WITH ROTARY KNOB.

A. Voltage: 120 and 277 volts.

B. Power Rating: 600 watts.

2.17 PROVIDE ACCESSORY WALL SWITCHES TO MATCH DIMMER APPEARANCE WHEN INSTALLED ADJACENT TO EACH OTHER.

A. FAN SPEED CONTROLLERS

2.18 DESCRIPTION: 120 V AC, SOLID-STATE, FULL-RANGE VARIABLE SPEED, SLIDE CONTROL TYPE WITH SEPARATE ON/OFF SWITCH, WITH INTEGRAL RADIO FREQUENCY INTERFERENCE FILTERING, FAN HUM ELIMINATION CIRCUITRY, FIELD-ADJUSTABLE TRIM, POWER FAILURE PRESET MEMORY, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 1917.

2.19 CURRENT RATING: 1.5 A UNLESS OTHERWISE INDICATED OR REQUIRED TO CONTROL THE LOAD INDICATED ON THE DRAWINGS.

A. RECEPTACLES

2.20 ALL RECEPTACLES: SELF-GROUNDING, COMPLYING WITH NEMA WD 1 AND NEMA WD 6, AND LISTED AS COMPLYING WITH UL 498, AND WHERE APPLICABLE, FS W-C-596; TYPES AS INDICATED ON THE DRAWINGS.

2.21 WIRING PROVISIONS: TERMINAL SCREWS FOR SIDE WIRING OR SCREW ACTUATED BINDING CLAMP FOR BACK WIRING WITH SEPARATE GROUND TERMINAL SCREW.

A. NEMA configurations specified are according to NEMA WD 6.

B. Convenience Receptacles:

2.22 STANDARD CONVENIENCE RECEPTACLES: COMMERCIAL SPECIFICATION GRADE, 20A, 125V, NEMA 5-20R; SINGLE OR DUPLEX AS INDICATED ON THE DRAWINGS.

A. Isolated Ground Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; single or duplex as indicated on the drawings.

B. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as weather resistant type

complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

C. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

D. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

E. GFI Receptacles:

2.23 ALL GFI RECEPTACLES: PROVIDE WITH FEED-THROUGH PROTECTION, LIGHT TO INDICATE GROUND FAULT TRIPPED CONDITION AND LOSS OF PROTECTION, AND LIST AS COMPLYING WITH UL 943, CLASS A.

A. Standard GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

B. Weather Resistant GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

C. Tamper Resistant GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.

D. Tamper Resistant and Weather Resistant GFI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.24 RECEPTACLES: HEAVY DUTY, COMPLYING WITH NEMA WD 6 AND WD 1.

A. Device Body: white plastic.

2.25 CONFIGURATION: NEMA WD 6, TYPE AS SPECIFIED AND INDICATED.

A. Convenience Receptacles: Type 5 to 15.

2.26 SINGLE CONVENIENCE RECEPTACLES.

A. Duplex Convenience Receptacles.

B. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

C. TELEPHONE AND DATA JACKS

D. WALL PLATES

2.27 ALL WALL PLATES: COMPLY WITH UL 514D.

2.28 CONFIGURATION: ONE PIECE COVER AS REQUIRED FOR QUANTITY AND TYPES OF CORRESPONDING WIRING DEVICES.

A. Size: Standard; .

B. Screws: Metal with slotted heads finished to match wall plate finish.

2.29 NYLON WALL PLATES: SMOOTH FINISH, HIGH-IMPACT THERMOPLASTIC.

A. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

B. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

C. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected.

E. Decorative Cover Plates: white, nylon.

F. Jumbo Cover Plates: Ivory, nylon.

G. Weatherproof Cover Plates: Gasketed cast metal with hinged.

H. FLOOR BOX SERVICE FITTINGS

2.30 DESCRIPTION: SERVICE FITTINGS COMPATIBLE WITH FLOOR BOXES PROVIDED UNDER SECTION 260537 WITH ALL COMPONENTS, ADAPTERS, AND TRIMS REQUIRED FOR COMPLETE INSTALLATION.

A. Above-Floor Service Fittings:

B. Flush Floor Service Fittings:

2.31 SINGLE SERVICE FLUSH CONVENIENCE RECEPTACLES:

A. Cover: Rectangular.

2.32 CONFIGURATION: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S) WITH DUPLEX FLAP OPENING(S).

A. Single Service Flush Communications Outlets:
   1. Cover: Rectangular.
   2. Configuration: .

2.33 SINGLE SERVICE FLUSH FURNITURE FEED:

2.34 COVER: RECTANGULAR.

2.35 CONFIGURATION: ONE 2-1/8 INCH BY 3/4 INCH COMBINATION THREADED OPENING(S).

A. Dual Service Flush Combination Outlets:

2.36 COVER: RECTANGULAR.

A. Configuration:

2.37 POWER: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S) WITH DUPLEX FLAP OPENING(S).

A. Communications: .

B. Dual Service Flush Furniture Feed:

2.38 COVER: RECTANGULAR.

A. Configuration:

2.39 POWER: ONE 2-1/8 INCH BY 3/4 INCH COMBINATION THREADED OPENING(S).

A. Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).

B. Accessories:

2.40 TILE RINGS: FINISH TO MATCH COVERS; CONFIGURATION AS REQUIRED TO ACCOMMODATE SPECIFIED COVERS.

A. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

B. Flush Cover Convenience Receptacles:

2.41 MATERIAL: BRASS.

2.42 FLUSH COVER COMMUNICATION OUTLETS:

2.43 FLUSH COVER COMBINATION FITTINGS:

A. Material: Brass.

2.44 PROTECTIVE RING: BRASS FINISH.

2.45 SPLIT NOZZLES: BRASS FINISH.

A. Carpet Rings: Brass.

B. POKE-THROUGH ASSEMBLIES

2.46 DESCRIPTION: ASSEMBLY COMPRISING FLOOR SERVICE FITTING, POKE-THROUGH COMPONENT, FIRE STOPS AND SMOKE BARRIERS, AND JUNCTION BOX FOR CONDUIT TERMINATION; FIRE RATING LISTED TO MATCH FIRE RATING OF FLOOR AND SUITABLE FOR FLOOR THICKNESS WHERE INSTALLED.

A. Above-Floor Service Fittings:

B. Flush Floor Service Fittings:

2.47 SINGLE SERVICE FLUSH CONVENIENCE RECEPTACLES:

2.48 CONFIGURATION: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S) WITH DUPLEX FLAP OPENING(S).

A. Single Service Flush Communications Outlets:
   1. Configuration:

2.49 VOICE AND DATA JACKS: AS SPECIFIED IN SECTION 271005.

A. Single Service Flush Furniture Feed:

2.50 CONFIGURATION: ONE 2 INCH BY 1-1/4 INCH COMBINATION THREADED OPENING(S).

A. Dual Service Flush Combination Outlets:

2.51 COVER: HINGED DOOR(S).

A. Configuration:

2.52 POWER: ONE STANDARD CONVENIENCE DUPLEX RECEPTACLE(S).

A. Communications: ___.

B. Voice and Data Jacks: As specified in Section 271005.

C. Dual Service Flush Furniture Feed:

2.53 CONFIGURATION:

2.54 POWER: ONE 3/4 INCH THREADED OPENING(S).

2.55 COMMUNICATIONS: TWO 1/2 INCH THREADED OPENING(S).

A. Accessories:

2.56 CLOSURE PLUGS: SIZE AND FIRE RATING AS REQUIRED TO SEAL UNUSED CORE HOLE AND MAINTAIN FIRE RATING OF FLOOR.

PART 3 EXECUTION

EXAMINATION

4.01 VERIFY THAT FIELD MEASUREMENTS ARE AS SHOWN ON THE DRAWINGS.

A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with CEC.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that final surface finishes are complete, including painting.

D. Verify that floor boxes are adjusted properly.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that core drilled holes for poke-through assemblies are in proper locations.

G. Verify that conditions are satisfactory for installation prior to starting work.

H. PREPARATION

4.02 PROVIDE EXTENSION RINGS TO BRING OUTLET BOXES FLUSH WITH FINISHED SURFACE.

A. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

B. INSTALLATION

4.03 PERFORM WORK IN A NEAT AND WORKMANLIKE MANNER IN ACCORDANCE WITH NECA 1, INCLUDING MOUNTING HEIGHTS SPECIFIED IN THAT STANDARD UNLESS OTHERWISE INDICATED.

A. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of wiring devices provided under this section.

4.04 MOUNTING HEIGHTS: UNLESS OTHERWISE INDICATED, AS FOLLOWS:

4.05 WALL SWITCHES: 48 INCHES ABOVE FINISHED FLOOR.

A. Wall Dimmers: 48 inches above finished floor.

B. Fan Speed Controllers: 48 inches above finished floor.

C. Receptacles: 18 inches above finished floor or 6 inches above counter.

4.06 ORIENT OUTLET BOXES FOR VERTICAL INSTALLATION OF WIRING DEVICES UNLESS OTHERWISE INDICATED.

A. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

B. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify LP Consulting Engineers to obtain direction prior to proceeding with work.

C. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

4.07 INSTALL WIRING DEVICES IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

A. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

B. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

C. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

D. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

F. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

G. Install wiring devices plumb and level with mounting yoke held rigidly in place.

H. Install wall switches with OFF position down.

I. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

J. Do not share neutral conductor on branch circuits utilizing wall dimmers.

K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

N. Install identification label for wall switches and wall dimmers in accordance with Section 260526 indicating load served when controlling loads that are not

visible from the control location or multiple wall switches or wall dimmers are installed at one location.

O. Install identification label for all receptacles in accordance with Section 260526 indicating serving branch circuit.

P. Install poke-through closure plugs in all unused core holes to maintain fire rating of floor.

Q. Install receptacles with grounding pole on top.

R. Connect wiring device grounding terminal to outlet box with bonding jumper.

S. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

T. Connect wiring devices by wrapping conductor around screw terminal.

U. Use jumbo size plates for outlets installed in masonry walls.

V. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

W. Install protective rings on active flush cover service fittings.

X. INTERFACE WITH OTHER PRODUCTS

4.08 COORDINATE LOCATIONS OF OUTLET BOXES PROVIDED UNDER SECTION 260537 TO OBTAIN MOUNTING HEIGHTS SPECIFIED.

A. Install wall switch 48 inches above finished floor.

B. Install convenience receptacle 18 inches above finished floor.

C. Install convenience receptacle 6 inches above counter.

D. Install dimmer 48 inches above finished floor.

E. Install telephone jack 18 inches above finished floor.

F. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

G. Coordinate installation of access floor boxes with access floor system provided under Section 096900.

H. FIELD QUALITY CONTROL

4.09 PERFORM FIELD INSPECTION, TESTING, AND ADJUSTING IN ACCORDANCE WITH SECTION 014000.

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify that each receptacle device is energized.

E. Test each receptacle to verify operation and proper polarity.

F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

H. Verify that each telephone jack is properly connected and circuit is operational.

I. ADJUSTING

4.10 ADJUST DEVICES AND WALL PLATES TO BE FLUSH AND LEVEL.

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

END OF SECTION 262726

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 REFERENCE STANDARDS

A. CEC – California electrical code.

B. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data sheets showing electrical characteristics, including time-current curves.

C. Maintenance Materials: Furnish the following for the District's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Fuses: Three of each type and size.

1.04 QUALITY ASSURANCE

A. Conform to requirements of CEC.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Cooper Bussmann

B. Ferraz Shawmut, Inc

C. Littelfuse

D. Or approved Equal

2.02 FUSES - GENERAL

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Rating suitable for circuit phase-to-phase voltage.

C. Main Service Switches Larger than 600 amperes: Class L (time delay).

D. Main Service Switches: Class RK1 (time delay).

E. Power Load Feeder Switches: Class RK1 (time delay).

F. Motor Load Feeder Switches: Class RK1 (time delay).

G. Lighting Load Feeder Switches: Class RK1 (time delay).

H. Other Feeder Switches: Class RK1 (time delay).

I. General Purpose Branch Circuits: Class RK1 (time delay).

J. Motor Branch Circuits: Class L time delay.

2.03 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.

B. Doors: Hinged, with hasp for the District's padlock.

PART 3 - EXECUTION

3.01 INSTALLATION0

A. Install fuses with label oriented such that manufacturer, type, and size are easily read.

B. Install spare fuse cabinet where indicated.

END OF SECTION 26 28 13

SECTION 28 46 00
FIRE DETECTIONS AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Circuits from protected premises to supervising station, including conduit.

D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

E. Maintenance of fire alarm system under contract for specified warranty period.

F. The fire alarm system shall consist of all necessary hardware equipment and software programming to perform the following functions:
   1. Fire alarm detection operations
   2. Control and monitoring of elevators, smoke control equipment and other equipment as indicated in the drawings and specifications.
   3. System shall tie into the existing Silent Knight and be fully integrated. New panel shall function as a network node to the existing FACP.

G. Thoroughly inspect the existing system and site conditions before bid. Advise the District's Representative of all conditions requiring immediate attention or might cause difficulties that are not addressed, or inferred to, in the contract drawings and specifications prior to new construction and the commencement of the guarantee period.

H. Review the Drawings and Specifications for work and material provided by others that will affect work specified under this Section. Carefully coordinate with other trades, equipment suppliers, contractors, etc. as required to provide a high-quality reliable installation with a minimum of construction delays. All work required to be re-accomplished due to lack of coordination shall be done at the Contractor's expense.

1.01 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage Power Circuits; 1991 (R1995).

C. CEC - California Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 72 - National Fire Alarm and Signaling Code; 2016.

E. California Building Code (CBC), California Electrical Code (CEC).

1.02 AMERICANS WITH DISABILITIES ACT (ADA)

A. All visual Notification appliances and manual pull stations shall comply with the requirements of the Americans with Disabilities Act or 2019 CBC, whichever is more stringent.

1.03 SUBMITTALS

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

B. Proposal Documents: Submit the following with cost/time proposal:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
   3. Certification by Contractor that the system design will comply with Contract Documents.
   4. Proposed maintenance contract.

C. Drawings must be prepared using AutoCAD Release 2017.
   1. TRUSD will provide floor plan drawings for Contractor's use; verify all dimensions on TRUSD-provided drawings.

D. Evidence of designer qualifications.

E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
   11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
   12. Certification by Contractor that the system design complies with Contract Documents.
   13. Do not show existing components to be removed.

F. Evidence of installer qualifications.

G. Evidence of instructor qualifications; training lesson plan outline.

H. Evidence of maintenance contractor qualifications, if different from installer.

I. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.

J. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Complete set of specified design documents, as approved by authority having jurisdiction.
   2. Additional printed set of project record documents and closeout documents bound or filed in same manuals.
   3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
   4. List of recommended spare parts, tools, and instruments for testing.
   5. Replacement parts list with current prices, and source of supply.
   6. Detailed troubleshooting guide and large-scale input/output matrix.
   7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to TRUSD.
   8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering contracts for remodeling.

K. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
   2. "As installed" wiring and schematic diagrams, with final terminal identifications.
   3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

L. Closeout Documents:
   1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
   2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
   3. Certificate of Occupancy.
   4. Maintenance contract.
   5. Report on training results.

M. Maintenance Materials, Tools, and Software: Furnish the following for TRUSD's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
3. In addition to the items in quantities indicated in PART 2, furnish the following:
   a. All tools, software, and documentation necessary to modify the fire alarm system using TRUSD's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
   b. One copy, on CD-ROM, of all software not resident in read-only-memory.

1.04 QUALITY ASSURANCE

A. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to TRUSD upon completion.

B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, , or installer

C. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
   3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
   4. Contract maintenance office located within 100 miles of project site.
   5. Certified in California as fire alarm installer.

D. Maintenance Contractor Qualifications: Same entity as installer.

E. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

F. WARRANTY
   1. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   2. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
   3. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 **MANUFACTURERS (MATCH CAMPUS EXISTING SYSTEM)**

A. Fire Alarm Control Units - Basis of Design: Notifier.

B. Existing Silent Knight 5820XL fire alarm control panel shall accommodate the new NODE panel. This integration shall result in a fully functional and integrated network as described in the plans and specifications.

C. Fire Alarm Control Units and Accessories:
   1. Provide control units made by the same manufacturer.

D. Initiating Devices and Notification Appliances:
   1. Same manufacturer as control units.

E. Substitutions: See Section 01 60 00 - Product Requirements.
   1. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
   1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
   2. Protected Premises: Entire building shown on drawings.
   3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards.
      b. The requirements of the State Fire Marshal.
      c. The requirements of the local authority having jurisdiction.
      d. Applicable local codes.
      e. Contract Documents (drawings and specifications).
      f. California Building Code (CBC).
      g. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
   4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
   5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
   6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
   7. Program notification zones as directed by TRUSD.
   8. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.
   9. Fire Command Center: Location indicated on drawings.
   10. Fire Alarm Control Unit: Existing, located at fire command center.
   11. Combined Systems: Do not combine fire alarm system with other non-fire systems.

B. Supervising Stations and Fire Department Connections:
   1. Public Fire Department Notification: By on-premises supervising station.
   2. Remote Supervising Station: UL-listed central station under contract to facility.

3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.

C. Circuits:
1. Initiating Device Circuits (IDC): Class B, Style 4.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 4.
3. Notification Appliance Circuits (NAC): Class B,

D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.

B. Clearly label components that are "Not in Service."

C. Remove unused existing components and materials from site and dispose of properly.

2.04 COMPONENTS

A. General:
1. Provide flush mounted units were installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit: As specified for Basis of Design above, or equivalent

B. Initiating Devices:
1. Addressable Manual Pull Stations: Silent Knight SK-Pull-DA
a. Provide 1 extra.
2. Smoke Detectors: Silent Knight SK-Photo-W.
3. Heat Detectors: Silent Knight SK-Heat-W.
a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
1) Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

C. Notification Appliances:
   1. Weatherproof Horn Strobe: Existing System Sensor P2RK.
   2. Strobes: Existing System Sensor SRL / SCRL
   3. Horn Strobe: Existing System Sensor P2RL / P2CRL
   4. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

D. FPE10 remote Power Supply with 2-8AH batteries.

E. The Power panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B Style Y rated at 2 amps each

F. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.

G. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

H. Emergency Power Supply:
   1. General: Components include battery, charger, and an automatic transfer switch.
   2. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 5 minutes.

I. Accessories: The contractor shall furnish the necessary accessories

J. Circuit Conductors: Copper; provide 200 feet extra; color code and label.

K. Locks and Keys: Deliver keys to TRUSD.
   1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type

R. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of TRUSD prior to mounting; mount in location acceptable to TRUSD.
   4. Provide extra copy with operation and maintenance data submittal.

S. Storage Cabinet for Spare Parts and Tools: Steel with baked enamel finish, size appropriate to quantity of parts and tools.
   1. Padlock eye and hasp for lock furnished by TRUSD.
   2. Locate as directed by TRUSD.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, CEC 2019, and the contract documents.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
   1. Factory trained and certified personnel.
   2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
   3. Personnel licensed or certified by state or local authority.

C. Conceal all wiring, conduit, boxes, and supports where installed in finished areas

D. Install all wiring in conduit, 3/4" minimum. No exception.

E. Existing Fire Alarm Equipment shall be maintained, and new control equipment and devices shall be 100% compatible with the existing system.

F. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

G. Install instruction cards and labels.

3.02 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose

3.03 INSPECTION AND TESTING FOR COMPLETION

A. Notify TRUSD 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work adjust for proper operation, and retest until entire system complies with Contract Documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. TRUSD will provide attendant operator personnel during diagnostic period; schedule training to allow TRUSD personnel to perform normal duties.
   4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.04 TRUSD PERSONNEL INSTRUCTION

A. Provide the following instruction to designated TRUSD personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: TRUSD furnished classroom, on-site or at other local facility.
   3. Factory Instruction: At control unit manufacturer's training facility.

B. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

C. Detailed Operation: Two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

D. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
   1. Initial Training: One 3-day session, pre-closeout.

E. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

F. Provide means of evaluation of trainees suitable to type of training given; report results to TRUSD.

3.05 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to TRUSD.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

3.06 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to TRUSD, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

D. Provide trouble call-back service upon notification by TRUSD:
   1. Provide on-site response within 24 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to TRUSD.
   3. TRUSD will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to TRUSD's representative upon completion of site visit.

G. Comply with TRUSD's requirements for access to facility and security.

END OF SECTION