

CONTRACT DOCUMENTS
for the

**REDLANDS FOOTHILL GROVES
WAREHOUSE CONVERSION
PHASE 1**

REDLANDS UNIFIED SCHOOL DISTRICT
REDLANDS, CALIFORNIA

April 22, 2025

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for the

**REDLANDS FOOTHILL GROVES
WAREHOUSE CONVERSION
PHASE 1**

REDLANDS UNIFIED SCHOOL DISTRICT
REDLANDS, CALIFORNIA

April 22, 2025

Architect

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Signing Engineers Name

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Signing Engineers Name

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Redlands Foothill Groves Warehouse Conversion

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304 9th Street

Redlands, CA 92373

Redlands Unified School District

TITLE

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PART 1 - GENERAL

1.1 SUMMARY OF THE WORK:

- A. The work under this Contract necessary for and incidental to the execution and completion all work indicated in the Contract Documents for construction of:

REDLANDS FOOTHILL GROVES WAREHOUSE CONVERSION PHASE-1

- B. Contract Documents prepared by:

PCH Architects, Inc.
30 South Center Street
Redlands, California 92373

1.2 GENERAL DESCRIPTION OF THE WORK:

- A. The work under this Contract includes furnishing of all labor, materials, services and transportation, except as specifically excluded, which is required for completion of the Project in accordance with the provisions of the Contract Documents. All construction shall be complete as indicated in the contract documents. The general scope of the work shall include but not be limited to:
1. Scope of work:
 2. Civil: Concrete dock, ramp, and retaining wall removal and replacement. AC paving removal and replacement.
 3. Structural: The project involves the conversion of an existing warehouse wood building into a large cooler and freezer facility. To accommodate the new layout, modifications will be made to the existing slab-on-grade, including the addition of concrete ramps and depressed slab areas. A new structural steel beam and column system will be installed to support the cooler and freezer enclosures, ensuring structural stability and integration with the existing building framework.
 4. Architectural: Minor upgrades to floor, wall, and ceiling. Framing for doors. CMU utility encloser. Fencing and gates.
 5. Food service cooler and freezer enclosures and equipment.
 6. Mechanical, electrical, plumbing, technology, fire alarm, fire sprinkler upgrades.

1.3 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Construction shall be in conformance with the California Code of Regulations (CCR), as follows:

2022 California Administrative Code, Part 1, Title 24, CCR
2022 California Building Code (CBC), Part 2, Title 24, CCR

2022 California Electrical Code (CEC), Part 3, Title 24, CCR
2022 California Mechanical Code (CMC), Part 4, Title 24, CCR
2022 California Plumbing Code (CPC), Part 5, Title 24, CCR
2022 California Energy Code, Part 6, Title 24, CCR
2022 California Fire Code (CFC), Part 9, Title 24, CCR
2022 California Existing Building Code (CEBC), Part 10, Title 24 CCR
2022 California Green Building Standards Code (CalGreen), Part 11, Title 24 CCR.
2022 California Referenced Standards Code, Part 12, Title 24, CCR
Title 19 CCR, Public Safety, State Fire Marshal Regulations

APPLICABLE STANDARDS:

For a list of applicable standards, including California amendments to the NFPA Standards, refer to CBC Chapter 35 and CFC Chapter 80.

1.4 OCCUPATIONAL SAFETY AND HEALTH ACT REQUIREMENTS:

- A. During the entire construction period, it shall be the responsibility of the Contractor to maintain conditions at the Project site so as to meet in all respects the requirements of the State and Federal Occupational Safety and Health Administration (Cal OSHA and OSHA). This provision shall cover the Contractor's employees and all other persons working upon or visiting the site or its vicinity including students and faculty. To this end, the Contractor shall inform himself and his representatives of State and Federal OSHA standards.

1.5 DOCUMENTS AVAILABLE:

- A. A soils investigation report has been performed for this project and is available for review at PCH Architects.

1.6 COORDINATION WITH STRUCTURAL REQUIREMENTS:

- A. The placement of pipes, conduits, other materials, and the location, size and reinforcement of holes in the building structure shall conform to the Structural Drawings and Specifications. When the requirements of the Mechanical, Electrical, or other sections of the Specifications or Drawings are in conflict with the structural requirements, the structural requirements shall take precedence. Where the safety of the building structure is threatened, due to mechanical, electrical or other construction or holes required for such construction, modifications shall be made as directed by the Architect.
- B. It is the Contractor's responsibility to coordinate the work so as to minimize conflicts and optimize efficiency.

1.7 WORK INDICATED AS N.I.C.:

- A. The term "NIC" shall be construed to mean that portions of the Project are not to be furnished, installed or performed by the Contractor. The term shall mean "Not in this Contract" or "Not a Part of the Work to be performed by the Contractor" except that

coordination and installation of certain NIC items specified shall be the Contractor's responsibility.

- B. "NIC" construction is indicated and specified herein as an aid to the Contractor in scheduling the amount of time and materials necessary for the completion of the Contract.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section covers procedures for submittal of requests for substitution for materials specified in this project manual by proprietary names. The Conditions of the Contract and other sections of Division 1 apply to this section as fully as if repeated herein.

1.2 GENERAL REQUIREMENTS:

- A. Whenever in the specifications products are by reference standard, any product meeting the standards referenced may be used. Information on such products shall be submitted in accordance with Section 01 33 23.
- B. The Contractor shall submit a written request for proposed substitutions, as permitted by Article 30 of the General Conditions, to the Architect not later than 35 days after the Award of Contract. Proposed substitutions relating to a particular subcontract or trade shall be submitted at one time on the Contractor's letterhead, listing proposed items for indicated or specified items, and stating amounts for all variations in costs. If the Architect approves any proposed substitution, such approval will be set forth in a Change Order. No substitution will be considered after this 35 day period.
- C. Drawings and Specifications have been detailed in compliance with the ICC Report and/or DSA approvals for material specified. If a proposed substitute material is approved as an equal by the Architect, the Contractor will assume the responsibility for construction modifications and additional costs required by reason of this acceptance.
- D. Where materials or items of manufacturer are specified in groups and are made or furnished by one manufacturer, no substitution will be considered that is not made and/or furnished similarly by one manufacturer. Where the Contractor proposes to use a system of equipment other than that specified or detailed on the drawings the substitution shall be proposed as a complete system.

1.3 REQUIREMENTS FOR SUBMITTING SUBSTITUTIONS:

- A. The Contractor shall submit with his written request for a proposed substitution all data substantiating his request as well as a "Certificate of Suitability" certifying that the proposed substitution is equal or better in all respects to that specified and that it will, in all respects perform the function for which it is intended. The Contractor shall include with his request all required samples. All written requests and data for proposed substitutions shall be submitted in three (3) copies.

- B. It shall be the responsibility of the Contractor to submit complete information to the Architect so that proper evaluation can be made. The burden of proof of equality of the substituted item shall be on the Contractor. Acceptance of such substitutions is entirely at the discretion of the Architect and Owner. All materials or items of manufacture, which the Contractor proposes to substitute for those specified, must be approved by the Architect before they may be ordered.
- C. The Architect will issue to the Contractor a list setting forth those items for which substitutions are approved. No substitution will be approved for any materials or item of manufacture called for in the Contract Documents which is not of equal quality and utility and which does not possess equal design or color characteristics to those of the specified material or item.
- D. If, in the opinion of the Architect or Owner, the proposed substitution is not equal or better in every respect to that so indicated or specified, or was not submitted for approval in the manner outlined above, the Contractor shall furnish the specified materials.
- E. It shall be the responsibility of the Contractor, in proposing a substitution for any item herein specified, to inform all other trades, vendors, and subcontractors of effects said substitution will have upon their work or products. Failure to so notify shall require that the Contractor bear all costs arising from alterations in specified materials or methods necessary to complete the work in an approved and acceptable manner.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section covers the requirements for pre-construction meeting, progress meetings, specially called meetings and post-construction meetings. The Conditions of the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.

1.2 CONTRACTOR'S RESPONSIBILITIES:

- A. Prepare agenda, notify participants, and make physical arrangements for all meetings.
- B. Record minutes, including all significant proceedings and decisions for each meeting. Reproduce and distribute copies of minutes within 5 days after each meeting. Provide copies to the Architect, all other participants in the meeting, and all other parties affected by decisions made at the meeting.

1.3 PRE-CONSTRUCTION MEETING:

- A. Prior to issuance of notice to proceed, a pre-construction meeting will be held at a time and location designated by the Architect.
- B. Attendance: The meeting shall be attended by the Owner's representative, the Owner's Inspector, the Architect and his professional consultants, the Contractor and his superintendent, all major subcontractors and other persons designated by the Owner.
- C. Agenda: The agenda for the meeting shall include the following items as a minimum.
 - 1. Distribution and discussion of the construction schedule including all critical work sequencing.
 - 2. Designation of persons authorized to represent and sign documents for the Owner, Architect and Contractor, with examples of official signature of each.
 - 3. Procedures and forms for processing submittals, field decisions, proposal requests, change orders, applications for payment and revised progress schedules.
 - 4. Procedures for maintaining record documents.

5. Contractor's use of premises including location of office, work and storage areas.
6. Temporary barricades, utilities, sanitary facilities, signs and other temporary facilities required.
7. Safety and first-aid procedures including designation of Contractor's safety officer.
8. Security procedures.
9. Housekeeping procedures.
10. Communication procedures between parties.
11. List names, addresses and telephone numbers of those persons authorized to act for the Contractor in emergencies.
12. Construction permit requirements, procedures and posting.
13. Testing laboratory or agency and testing procedures.
14. Establish schedule for progress meetings.
15. Other administrative items as appropriate.

1.4 PROGRESS MEETINGS:

- A. Progress meetings shall be held at the dates and times scheduled at the pre-construction meeting unless changes are agreed to by all parties and appropriate notification of such changes has been given.
- B. Attendance: The meeting will be attended by the Architect, the Contractor's Superintendent and the Owner's Inspector. When requested by the Owner, the Architect or the contractor; subcontractors, and the Architect's Consultants may also attend.
- C. Agenda: The agenda for these meetings will include the following items.
 1. Review progress of work since the previous meeting.
 2. Discuss field observations, problems and conflicts.
 3. Identify problems which impede planned progress and develop corrective measures as required to regain the projected schedule. Revise the progress schedule if necessary.

4. Review progress scheduled during the next work period.
5. Review the progress of sub-contractors.
6. Review changes proposed by the Owner for their effect on the progress schedule and completion time.

1.5 SPECIAL MEETINGS:

- A. Upon appropriate notice to other parties, special meetings may be called by the Owner or Architect, at times agreed to by all parties involved.

1.6 POST-CONSTRUCTION CONFERENCE:

- A. A post-construction conference will be held prior to final inspection of the work to discuss and resolve all unsettled matters. Bonds and insurance to remain in force, and the other documents required to be submitted by the Contractor will be reviewed and all deficiencies determined. Schedules and procedures for the final inspection process and for the correction of defects and deficiencies shall be discussed and agreed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the preparation and submission of the schedules and reports specified herein, including the up-to-date maintenance thereof as required. The Conditions of the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.

1.2 CONSTRUCTION SCHEDULE:

- A. Immediately upon being awarded the Contract and before request for a partial payment, the Contractor shall prepare and submit to the Architect a construction progress schedule. The schedule shall be prepared in chart form according to the Critical Path Method (CPM) with the dates for beginning and completion of each trade and activity included. Computer prepared CPM charts are acceptable. The schedule shall conform to the working time and the time of completion established under the terms of the Contract and shall be subject to modification by and approval of the Owner. When, in the opinion of the Owner, it becomes necessary to accelerate the work, the Contractor, when so ordered, shall modify the schedule to conform to such requirements.
- B. The Construction Schedule shall be continuously updated and, if necessary, redrawn and submitted simultaneously with the application for progress payments. Each revised schedule shall indicate the work actually accomplished during the previous period and the schedule for completion of the remaining work.
- C. A copy of the most recent updated Construction Schedule shall be posted in the Contractor's job office, and copies of all out-of-date schedules shall be kept at the job office at all times for perusal by the Owner.

1.3 SUBMITTAL SCHEDULE:

- A. The Contractor shall also furnish a separate schedule along with the Construction Schedule specified above, showing the proposed dates for submittal of all samples, shop drawings, and product data.
- B. Submit two copies of the submittal schedule to the Architect.

1.4 SCHEDULE OF VALUES:

- A. Immediately upon being awarded the Contract, and before request for payment, prepare and submit to the Architect a Schedule of Values allocated to the various portions of the work. This Schedule of Values, unless objected to by the Architect, shall be used only as the basis for the Contractor's Applications for Payment.
- B. The schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction. Follow the table of contents of this Project Manual as the format for listing component items. For each major line item list sub-values of major products or operations under the item, where applicable.
- C. Each item shall include a directly proportional amount of the Contractors overhead and profit.
- D. For items on which progress payments will be requested for stored materials, break down the value into (1) the cost of the materials, delivered and unloaded, with taxes paid, and (2) the total installed value.
- E. The sum of all values listed in the schedule shall equal the total Contract sum.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples and other Submittals.
- B. All submittals shall be submitted electronically, unless actual product materials require review for approval. The Contractor is responsible for submitting required product data, in portable document format (pdf), to the Architect for review.
- C. Related Sections include the following:
 - 1. Division 01 Section "Payments and Procedures" for submitting Application for Payment and Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting minutes and coordination drawings.
 - 3. Division 01 section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and Submittals Schedule.
 - 4. Division 01 section "Photographic Documentation" for submitting construction photographs.
 - 5. Division 01 section "Quality Requirements" for submitting test and inspection reports and mock-up requirements.
 - 6. Division 01 section "Closeout Procedures" for submitting warranties.
 - 7. Division 01 section "Project Record Documents" for submitting record drawings, record specifications and product data.
 - 8. Division 02 through 33 sections for specific requirements for submittals in those sections.

1.2 SAMPLES:

- A. Submit samples in accordance with the General Conditions as modified and supplemented herein. Furnish for review samples of the various materials, together with the finish thereon, as specified for and intended to be used on or in the work. Samples shall be sent to the office of the Architect, carriage prepaid.
- B. Submit all samples to the Architect for review before purchasing, fabricating, applying, or installing such materials and finishes. The Architect will review and take action on samples within 10 working days of the Contractor's submission. All actions will be by the Architect in writing.

- C. Submit all samples, other than field samples, in quadruplicate. A covering letter shall accompany the samples and shall list all items being transmitted, designating their particular usage and location in the project and shall be identified as to manufacturer, trade name, style, model, etc. One approved sample will be returned to the Contractor.
- D. Approval of a sample shall not be taken in itself to change or modify any contract requirement. All materials, finishes, and workmanship in the completed building shall be equal in every respect to that of the approved sample.
- E. Unless otherwise specified, samples shall be 8" x 10" in size and shall be limited in thickness to a minimum consistent with sample analysis. In lieu thereof, the actual full size item may be submitted.
- F. Samples of value may be returned to the Contractor for use in the project after review, analysis, comparison and/or testing as may be required by the Architect, provided that the location is recorded and the samples bear temporary identification as samples.
- G. Field samples shall be prepared at the site by the Contractor as specified in the various sections of these Specifications. Affected finished work shall not be commenced until the Architect has given written approval for the field samples.

1.3 SHOP DRAWINGS AND PRODUCT DATA:

- A. Shop Drawings: The term "shop drawings" as used herein includes fabrication and installation, layout, and setting drawings; wiring and control diagrams; and other drawings. Submit shop drawings in accordance with the General Conditions as modified and supplemented herein.
 - 1. The Contractor shall check and verify all field measurements and shall submit for review, with such promptness as to cause no delay in his own work or in that of any other contractor or subcontractor, all shop or setting drawings and schedules required for the work of the various trades. Shop drawings shall be prepared at the Contractor's expense and shall be sent to the Division of the Architect, carriage prepaid.
 - 2. Drawings shall show all information required by the applicable Technical Section and shall be in sufficient detail as may be required to show that fabricated materials, equipment or systems, and the positions thereof conform to the Contract Documents.
 - 3. Shop drawings shall establish the actual detail of all fabricated items, indicate proper relation of adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual conditions. Shop drawings shall be drawn to scale and shall be completely dimensioned.

4. Composite Shop Drawings and Field Layouts: Prepare and submit composite Shop Drawings and field layouts as required to solve tight field conditions and when required to coordinate the Work of several trades. Include dimensioned plans, elevations, sections, and details and give complete information particularly as to kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, and structural interferences. Coordinate these composite Shop Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervising field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified for Shop Drawings.
 5. Prepare shop drawings on sheet of same size as project drawings or on 8-1/2" x 11" suitable for reproduction.
 6. Each shop drawing shall have a title block containing the following information.
 - a. Name and location of the project.
 - b. Name and address of the Contractor.
 - c. Name and address of the subcontractor, manufacturer, supplier or distributor as applicable.
 - d. Name and address of Owner.
 - e. Date, scale of drawings and identification number.
 - f. Space for the Contractor's review and approval stamp.
 7. Submit three blue or black line prints and one reproducible transparency of each shop drawing.
- B. Product Data: The term "product data" as used herein includes manufacturer's standard drawings, certificates of conformance, substantiating calculations and other data.
1. The data shall include all information required by the applicable technical section and shall be in sufficient detail to show that manufactured materials and equipment conform to the Contract Documents.

2. Catalog Cuts: Clearly mark each copy to indicate the product or model as well as all optional sizes, finishes or other features proposed for use. Delete all inapplicable data.
 3. Submittal Preparation: Bind product data with sturdy labeled covers with an index listing the contents. Loose unbound submittals will be returned without review. Submit eight copies of all product data.
- C. Architect's Action: The Architect will review the submittals with reasonable promptness and will affix the Architect's initials or signature as follows:
1. Submittals stamped "NO EXCEPTION TAKEN" require no resubmittal and fabrication and/or construction may proceed. The Architect will return to the Contractor, the stamped transparency of shop drawings and four stamped copies of brochures, schedules, materials lists, and other product data, except where required otherwise.
 2. Submittals stamped "MAKE CORRECTIONS NOTED", require no resubmittal and fabrication and/or construction may proceed contingent upon all corrections being made as noted.
 3. Submittals stamped "REJECTED" or "REVISE AND RESUBMIT", require the Contractor to resubmit them with reasonable promptness and no fabrication or construction may begin. The Architect will return to the Contractor; one stamped transparency and one marked copy of shop drawings and one marked copy and six unmarked copies, all stamped, of brochures, schedules, materials lists, and other product data.
 4. Resubmittals. If first or subsequent submittal is stamped "REJECTED" or "REVISE AND RESUBMIT", corrective action shall be taken and resubmittal procedure shall be as same as for first submittal. The Contractor shall direct specific attention in writing on resubmitted shop drawing to revisions other than the correction requested by the Architect on previous submissions.
 5. Distribution copies: The Contractor shall be responsible for obtaining required prints and for distribution to Subcontractors. All distribution copies shall be made from the transparency bearing the Architect's completed stamp.
- D. The Architect will review and take action on such drawings and schedules only for conformance with the design concept of the project and compliance with information given in the contract documents. When so directed by the Architect, the Contractor shall make corrections required by the Architect.

- E. The shop drawings, product data and supporting data shall be prepared by the Contractor or his suppliers and subcontractors, but shall be submitted as the instruments of the Contractor.
- F. The Contractor shall check the drawings of his suppliers and subcontractors as well as his own drawings before submitting them. In particular, the Contractor shall ascertain that the drawings meet all requirements of the contract drawings and specifications and conform to the structural and space conditions. If such shop drawings show variations from contract documents, whether because of standard shop practice or other reasons, the Contractor shall clearly describe such variations including other changes required to correlate the work in his letter of transmittal.
- G. Shop drawings submitted to the Architect for review shall be accompanied by a written statement signed by the Contractor, that the shop drawings have been checked by him and found to be in accordance with the contract drawings and specifications and that proper provision has been made to accommodate all abutting work. This statement may be in the form an approval stamp bearing the Contractor's signature.
- H. Substantiation calculations, when specified, shall be prepared and signed by a California registered Civil or Structural Engineer, employed by the Contractor.
- I. The Architect's review of shop drawings will be general only and shall not relieve the Contractor from responsibility for errors of any sort, for deviations from drawings or specifications, or for conflict with the work of others that may result from such deviations. Architect's review of a separate item does not indicate a review of an assembly in which the item functions.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the preparation and submission of samples, shop drawings and product data as specified herein and in the various sections of these specifications. The requirements specified herein are in addition to any requirements for samples and shop drawings, product data materials lists, substitutions of materials, or other submittals specified elsewhere in these specifications. The Conditions of the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.

1.2 DEFINITIONS:

- A. As used herein, the term "manufactured" applies to standard units usually mass-produced; and "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements.

1.3 GENERAL SUBMITTAL PROCEDURES:

- A. Scheduling: Submit samples, shop drawings, and product data in accordance with the schedule specified in Section 01 32 16. Extension of Contract time will not be granted because of the Contractor's failure to make timely submittals. Do not purchase materials or equipment or begin work covered by the required submittals until submittals have been reviewed and returned.
- B. Transmittal: Accompany each submittal with a dated, signed and sequence numbered transmittal on forms prescribed by the Architect. Include all information required by this form including project identification, name and address of Contractor and of subcontractor or supplier, a list of items included in the submittal, and identification of drawing numbers, specification section and paragraph numbers to which the submittal pertains, and space for Contractors review and approval stamp.
- C. Check of Returned Submittals: Check the submittals returned for correction and ascertain if the corrections result in extra cost above that included under the Contract Documents, and give written notice within five days if, in Contractor's opinion, such extra cost results from corrections. By failing to so notify or by starting any work covered by a submittal, Contractor waives all claims for extra costs resulting from required corrections.

1.4 SAMPLES:

- A. Submit samples in accordance with Article 32 of the General Conditions as modified and supplemented herein. Furnish for review samples of the various materials, together with the finish thereon, as specified for and intended to be used on or in the work. Samples shall be sent to the office of the Architect, carriage prepaid.
- B. Submit all samples to the Architect for review before purchasing, fabricating, applying, or installing such materials and finishes. The Architect will review and take action on samples within 10 working days of the Contractor's submission. All actions will be by the Architect in writing.
- C. Submit all samples, other than field samples, in quadruplicate. A covering letter shall accompany the samples and shall list all items being transmitted, designating their particular usage and location in the project and shall be identified as to manufacturer, trade name, style, model, etc. One approved sample will be returned to the Contractor.
- D. Approval of a sample shall not be taken in itself to change or modify any contract requirement. All materials, finishes, and workmanship in the completed building shall be equal in every respect to that of the approved sample.
- E. Unless otherwise specified, samples shall be 8" x 10" in size and shall be limited in thickness to a minimum consistent with sample analysis. In lieu thereof, the actual full size item may be submitted.
- F. Samples of value may be returned to the Contractor for use in the project after review, analysis, comparison and/or testing as may be required by the Architect, provided that the location is recorded and the samples bear temporary identification as samples.
- G. Field samples shall be prepared at the site by the Contractor as specified in the various sections of these Specifications. Affected finished work shall not be commenced until the Architect has given written approval for the field samples.

1.5 SHOP DRAWINGS AND PRODUCT DATA:

- A. Shop Drawings: The term "shop drawings" as used herein includes fabrication and installation, layout, and setting drawings; wiring and control diagrams; and other drawings. Submit shop drawings in accordance with Article 31 of the General Conditions as modified and supplemented herein.
 - 1. The Contractor shall check and verify all field measurements and shall submit for review, with such promptness as to cause no delay in his own work or in that of any other contractor or subcontractor, all shop or setting drawings and schedules

required for the work of the various trades. Shop drawings shall be prepared at the Contractor's expense and shall be sent to the Division of the Architect, carriage prepaid.

2. Drawings shall show all information required by the applicable Technical Section and shall be in sufficient detail as may be required to show that fabricated materials, equipment or systems, and the positions thereof conform to the Contract Documents.
3. Shop drawings shall establish the actual detail of all fabricated items, indicate proper relation of adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual conditions. Shop drawings shall be drawn to scale and shall be completely dimensioned.
4. Composite Shop Drawings and Field Layouts: Prepare and submit composite Shop Drawings and field layouts as required to solve tight field conditions and when required to coordinate the Work of several trades. Include dimensioned plans, elevations, sections, and details and give complete information particularly as to kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, and structural interferences. Coordinate these composite Shop Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervising field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified for Shop Drawings.
5. Prepare shop drawings on sheet of same size as project drawings or on 8-1/2" x 11" suitable for reproduction.
6. Each shop drawing shall have a title block containing the following information.
 - B. Name and location of the project.
 - C. Name and address of the Contractor.
 - D. Name and address of the subcontractor, manufacturer, supplier or distributor as applicable.
 - E. Name and address of Owner.
 - F. Date, scale of drawings and identification number.
 - G. Space for the Contractor's review and approval stamp.

1. Submit three blue or black line prints and one reproducible transparency of each shop drawing.
- H. Product Data: The term "product data" as used herein includes manufacturer's standard drawings, certificates of conformance, substantiating calculations and other data.
1. The data shall include all information required by the applicable technical section and shall be in sufficient detail to show that manufactured materials and equipment conform to the Contract Documents.
 2. Catalog Cuts: Clearly mark each copy to indicate the product or model as well as all optional sizes, finishes or other features proposed for use. Delete all inapplicable data.
 3. Submittal Preparation: Bind product data with sturdy labeled covers with an index listing the contents. Loose unbound submittals will be returned without review. Submit eight copies of all product data.
- I. Architect's Action: The Architect will review the submittals with reasonable promptness and will affix the Architect's initials or signature as follows:
1. Submittals stamped "NO EXCEPTION TAKEN" require no resubmittal and fabrication and/or construction may proceed. The Architect will return to the Contractor, the stamped transparency of shop drawings and four stamped copies of brochures, schedules, materials lists, and other product data, except where required otherwise.
 2. Submittals stamped "MAKE CORRECTIONS NOTED", require no resubmittal and fabrication and/or construction may proceed contingent upon all corrections being made as noted.
 3. Submittals stamped "REJECTED" or "REVISE AND RESUBMIT", require the Contractor to resubmit them with reasonable promptness and no fabrication or construction may begin. The Architect will return to the Contractor; one stamped transparency and one marked copy of shop drawings and one marked copy and six unmarked copies, all stamped, of brochures, schedules, materials lists, and other product data.
 4. Resubmittals. If first or subsequent submittal is stamped "REJECTED" or "REVISE AND RESUBMIT", corrective action shall be taken and resubmittal procedure shall be as same as for first submittal. The Contractor shall direct specific attention in writing on resubmitted shop drawing to revisions other than the correction requested by the Architect on previous submissions.

5. Distribution copies: The Contractor shall be responsible for obtaining required prints and for distribution to Subcontractors. All distribution copies shall be made from the transparency bearing the Architect's completed stamp.
- J. The Architect will review and take action on such drawings and schedules only for conformance with the design concept of the project and compliance with information given in the contract documents. When so directed by the Architect, the Contractor shall make corrections required by the Architect.
- K. The shop drawings, product data and supporting data shall be prepared by the Contractor or his suppliers and subcontractors, but shall be submitted as the instruments of the Contractor.
- L. The Contractor shall check the drawings of his suppliers and subcontractors as well as his own drawings before submitting them. In particular, the Contractor shall ascertain that the drawings meet all requirements of the contract drawings and specifications and conform to the structural and space conditions. If such shop drawings show variations from contract documents, whether because of standard shop practice or other reasons, the Contractor shall clearly describe such variations including other changes required to correlate the work in his letter of transmittal.
- M. Shop drawings submitted to the Architect for review shall be accompanied by a written statement signed by the Contractor, that the shop drawings have been checked by him and found to be in accordance with the contract drawings and specifications and that proper provision has been made to accommodate all abutting work. This statement may be in the form an approval stamp bearing the Contractor's signature.
- N. Substantiation calculations, when specified, shall be prepared and signed by a California registered Civil or Structural Engineer, employed by the Contractor.
- O. The Architect's review of shop drawings will be general only and shall not relieve the Contractor from responsibility for errors of any sort, for deviations from drawings or specifications, or for conflict with the work of others that may result from such deviations. Architect's review of a separate item does not indicate a review of an assembly in which the item functions.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes testing laboratory services and inspections required during the course of construction, as specified herein. The Conditions of the Contract and Division 1 apply to this section as fully as if repeated herein.

1.2 TESTING LABORATORY:

- A. Testing and inspections will be performed by an independent testing laboratory selected and paid by the Owner.
- B. Testing and inspection services which are performed shall be in accordance with requirements of Title 24, Part 2, California Code of Regulations, Chapter 17 as specified herein. Testing and inspection services shall verify that work meets the requirements of the Contract Documents.
- C. Test reports shall be signed by a Registered Civil Engineer licensed in the State of California.

1.3 PAYMENTS:

- A. Costs of initial testing and inspection, except as specifically modified hereinafter or specified otherwise in technical sections, will be paid for by the Owner, providing such testing and inspection indicates compliance with Contract Documents. Initial tests and inspections are defined as the first tests and inspections as hereinafter specified.
- B. In the event a test or inspection indicates failure of a material or procedure to meet requirements of Contract Documents, costs for retesting and reinspection will be paid by the Owner and backcharged to the Contractor.
- C. Additional tests and inspections not herein specified but requested by Owner or Architect, will be paid for by Owner, unless results of such tests and inspections are found to be not in compliance with Contract Documents, in which case the Owner will pay all costs for initial testing as well as retesting and reinspection and backcharge the Contractor.
- D. Costs for additional tests or inspections required because of change in materials being provided or change of source or supply will be paid by Owner and backcharged to the Contractor.
- E. Costs for work which is required to correct deficiencies shall be borne by the Contractor.

- F. Cost of testing which is required solely for the convenience of Contractor in his scheduling and performance of work shall be borne by the Contractor.
- G. Testing Laboratory will separate and identify on the invoices, the costs covering all testing and inspections which are to be backcharged to the Contractor as specified above.
- H. Testing Laboratory will furnish to Owner a cost estimate breakdown covering initial tests and inspections required by Contract Documents. Estimate will include number of tests, man-hours required for tests, field and plant inspections, travel time, and costs.

1.4 TEST AND INSPECTION REPORTS:

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

1.5 REPORTING TEST FAILURES:

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

1.6 AVAILABILITY OF SAMPLES:

- A. Contractor shall make materials required for testing available to Laboratory and assist in acquiring these materials as directed by the Owner's inspector. The samples shall be taken under the immediate direction and supervision of the Testing Laboratory.
- B. If work which is required to be tested or inspected is covered up without prior notice or approval, such work, may be uncovered at the discretion of Architect at no additional cost to the Owner. Refer to paragraph 1.3 payments.
- C. Unless otherwise specified, Contractor shall notify Testing Laboratory a minimum of ten (10) working days in advance of all required tests, and a minimum of two (2) working days in advance of all required inspections. Extra laboratory expenses resulting from a failure to notify the Laboratory will be paid for by the Owner and backcharged to the Contractor.
- D. Contractor shall give sufficient advance notice to Testing Laboratory in the event of cancellation or time extension of a scheduled test or inspection. Charges due to insufficient advance notice of cancellations or time extension will be paid for by the Owner and backcharged to the Contractor.

1.7 REMOVAL OF MATERIALS:

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

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TESTS AND INSPECTIONS:

- A. Tests and inspections as required by the California Code of Regulations, Title 24, Part 2, for the following will be required, as applicable:
- B. Soils and Foundations (CBC Chapter 18)
 - 1. Earth Fill Compaction: 1803.5.8
- C. Concrete (CBC Chapter 19)
 - 1. Materials:
 - Portland Cement Tests: 1903.1, 1910.1
 - Concrete Aggregates: 1903.5, 1908.3
 - Reinforcing Bars: 1903-8, 1908.4, 1910.2
 - Batch Plant Inspection: 1705.3.3
 - 2. Concrete Quality:
 - Proportions of Concrete: 1903.6, 1908.2
 - Mixing and Placing: ACI 318
 - Strength Tests of Concrete: 1905.1.15, 1908.10
 - Composite Construction Cores: 1909.2.6
 - 3. Concrete Inspection:
 - Job Site Inspection: 1705.3.5
 - Batch Plant or Weighmaster Inspection: 1705.3.3
 - Reinforcing Bar Welding Inspection: ACI 318, 1903.8
 - Post-Installed Anchors: 1910.5
- D. Masonry (CBC Chapter 21)
 - 1. Materials:
 - Masonry Units: 2103.1
 - Portland Cement: 1910.1, ACI 318
 - Mortar & Grout Aggregates: 2103.2, 2103.3.1
 - Reinforcing Bars: 2103.4
 - 2. Masonry Quality:
 - Portland Cement Tests: 1705.3.2, 1903.1, 1910.4
 - Mortar & Grout Tests: 2105.3
 - Masonry Core Tests: 2105.4
 - Reinforcing Bar Tests: 1910.2, 2103.4
 - Masonry Units: 2105.1

3. Masonry Inspection:
Reinforced Masonry: 1705.4, 2106.1
Reinforcing Bar Welding Inspection: 1705.3.1, 1903.8
- E. Structural Steel (CBC Chapter 22)
 1. Materials:
Structural Steel, Cold Formed Steel: 2205, 2211
Material Identification: 2202.1
 2. Inspection of Structural Steel and Steel Quality:
Test of Structural Steel: 1705.2
Tests of H.S. Bolts, Nuts, Washers: 2213.1
Tests of End Welded Studs: 2213.2
High Strength Bolt Installation: AISC 360M2.5
Welding Inspection: 1705.2.5
Nondestructive Weld Testing: 1705.2.5
Inspection of Shop Fabrication: 1704.2.5, 1704.3
Spray Applied Fire Resistance Materials: 1705.14
- F. Wood (CBC Chapter 23)
 1. Materials:
Lumber Grading: 2303.1.1
Plywood Grading: 2303.1.1.1
Glued-Laminated Timbers: 2303.1.3
Glued Cross Laminated Members: 2303.1.3
 2. Wood Inspection: 1705.5
Glued Laminated Timber: Shop Fabrication: 1705.5.4
Open Web Joists: Shop Fabrication: 1705.5.5
Timber Connectors: 1705.5.6

3.2 EARTHWORK:

- A. The Owner's Soils Engineer will provide continuous inspection of fill and will field test fill and earth backfill as placed and compacted and inspect excavations and subgrade before concrete is placed and provide periodic inspection of open excavations, embankments, and other cuts or vertical surfaces of earth. The Soils Engineer will submit a report indicating that he has observed and tested excavations and fills and that in his opinion the work is in accordance with the project specifications and Geotechnical Report.
- B. Contractor shall remove unsatisfactory material, re-roll, adjust moisture, place new material, or in the case of excavations, provide proper protective measures, perform other operation necessary, as directed by the Architect whose decisions and directions will be considered final.

C. Soils Test and Inspection Procedure:

1. Allow sufficient time for testing, and evaluation of results before material is needed. The Soils Engineer shall be sole and final judge of suitability of all materials.
2. Laboratory compaction tests to be used will be in accordance with ASTM D 1557.
3. Field density tests will be made in accordance with ASTM D 1556.
4. Number of tests will be determined by Soils Engineer. Materials in question may not be used pending test results.
5. Excavation and embankment inspection procedure. Soils Engineer will determine bearing values.

3.3 TESTING OF CONCRETE:

A. Concrete Mix Design:

1. The Owner will pay for the sampling of aggregate and preparation of mix design one time for each strength and/or aggregate size specified. Testing cost for additional mix designs will be paid for by the Owner and backcharged to the Contractor. Continuous plant inspection and all tests of materials will be paid by the Owner, but the Contractor will be backcharged for all tests performed on materials that do not meet specification requirements.
2. Test concrete aggregates for mix design only.
3. Deliver samples of approved aggregate to job for comparison with material delivered, if job-mixed concrete is used.
4. Test suitability of aggregates in accordance with ASTM C-88 if material is under suspicion.

B. If compressive test of core specimens fail to show compressive strength specified, remove and replace concrete.

C. Make all tests, take samples, and prepare samples in accordance with the latest standards adopted by American Society for Testing and Materials, referred to as ASTM.

D. Concrete mixed at certified automatic concrete batch plants shall have quality control as follows:

1. Laboratory designed mixes using adequate cement factors.

2. The testing laboratory shall perform continuous batch plant inspection.
- E. Concrete mixed at non-certified plants shall have quality control as follows:
1. Laboratory designed mixes using adequate cement factors.
 2. Continuous batch plant inspection.
 3. Measure all water, including wash water, so total on truck does not exceed 95% max. allowed in mix design.
 4. Legible, certified weighmaster's certificates shall be provided the Inspector for all structural and non-structural concrete.
 5. At end of job, fill up form required by the Building Department, certifying that all concrete furnished conformed in every particular to requirements of California Code of Regulations, Title 24, Parts 1 and 2.
- F. Owner's Inspector shall do the following:
1. Inspect placing of reinforcing steel and concrete at job.
 2. Obtain load ticket and identify mix before accepting load. Keep daily record of pour, identifying each truck load, time of receipt, and location of concrete in structure.
 3. During progress of work, take reasonable number of test cylinders as directed by Architect, but at least one set of cylinders for each 100 cu. yds. or fractional part thereof for each class of concrete and at least one set of each day's pour. Test cylinders need not be made for concrete used in walks.
 4. One set of cylinders shall consist of three samples all taken from same batch, one to be tested at age of 10-days and one at 28-days.
 5. Make and store cylinders according to "Making and Curing Concrete Compression and Flexural Strength Test Specimens in the Field," ASTM C31.
 6. Deliver cylinders to laboratory or store cylinders in a suitable protected environment for pick-up by laboratory personnel.
 7. Make slump test of wet concrete according to test for slump of Portland cement concrete, ASTM C143, at least at the same frequency that the cylinders are taken.

3.4 REINFORCING STEEL:

- A. Tests:

1. Tests shall be performed prior to the delivery of steel to job site. Steel not meeting specifications shall not be shipped to the job.
 2. Testing procedure shall conform to ASTM A 615.
 3. Sample at the place of distribution, prior to shipment. Make one tensile test and one bending test from samples out of 10 tons, or fraction thereof, of each size and kind of reinforcing steel, where taken from bundles as delivered from the mill and properly identified as to heat number. Mill analysis shall accompany report. Where identification number cannot be ascertained, or where random samples are taken, make one series of tests from each 2-1/2 tons, or fraction thereof, of each size and kind of reinforcing steel. Samples shall include not fewer than two pieces, each 18 inches long, of each size and kind of reinforcing steel No. 5 and larger. Inspection of welding of reinforcing steel shall be done in the presence of a specially qualified laboratory inspector.
- B. Owner's Inspector will inspect all reinforcement for concrete work for size, dimensions, locations and proper placement.

3.5 STRUCTURAL STEEL:

- A. Mill certificates or affidavits and manufacturers' certification shall be supplied to the Inspector for verification of steel materials. Testing Laboratory shall be notified at least two (2) working days in advance of fabrication and supplied with the reports so that he can make a shop inspection of the steel.
- B. Tests of steel materials: See Section 05 12 00 for tests required for local stock or unidentified steel. Such testing will be paid for by the Owner and Backcharged to the Contractor.
- C. General Inspection:
1. Testing Laboratory will visit the fabricator's plant to verify that materials used check with the mill tests, affidavits of test reports, and that fabrication and welding procedures meet specification.
 2. Testing Laboratory will visually check fabricated steel delivered to the job against the working and reviewed shop drawings for compliance and he will make physical tests, measurements, as required to meet the specifications. Shop fillet welds will be visually checked.
 3. Inspection of Shop Fabrication: Inspection of shop fabrication shall be required for important work. This inspection shall be made by a qualified inspector approved by the City having jurisdiction. He shall furnish the Architect, Structural Engineer, and Building Department a report duly verified by him that the materials and workmanship conform to the approved plans and specifications.

4. Inspection of welding shall be in accordance with the requirements of California Code of Regulations, Title 24, Part 2, Section 1705.2.5

D. Inspection and Tests for End Welded Studs:

1. Inspection, in accordance with California Code of Regulations, Title 24, Part 2, Section 2213.2, of all the shop and field welding operations including the installation of automatic end welded studs shall be made by a qualified welding inspector approved by Building Department. The type and capacity of the welding equipment shall be in accordance with the manufacturer's recommendations and shall be checked and approved by a welding inspector.
2. At the beginning of each day's work, a minimum of two stud welds shall be made with the equipment to be used to metal which is the same as the actual work piece. The test studs shall be subjected to a 90 degree bend test by striking them with a heavy hammer. After the above test, the weld section shall not exhibit any tearing out or cracking.

3.6 MASONRY:

A. Job Inspector:

1. All masonry work shall be continuously inspected during laying and grouting by an Inspector, to comply with Title 24, Part 1, Section 4-211(c) The Inspector shall make test samples and perform such tests as are required.
2. The Inspector shall check the materials, details of construction and construction procedure. The Inspector shall furnish a verified report that of his own personal knowledge the work covered by the report has been performed and materials used and installed are in every particular in accordance with, and in conformity to, the duly approved drawings and specifications.

B. Masonry Tests:

1. Concrete and Hollow Clay Masonry Units: Test each type of unit for strength in accordance with ASTM C 140; for drying shrinkage in accordance with ASTM C 426; and for staining materials in lightweight concrete in accordance with ASTM C 641.
2. Mortar and Grout Tests: At the beginning of all masonry work, at least one test sample of the mortar and grout shall be taken on three successive working days and at least at one week intervals thereafter. The samples shall be continuously stored in moist air until tested. They shall meet the minimum strength requirement given in Section 2105A.3 for mortar and grout. Additional samples shall be taken whenever any change in materials or job conditions occur or whenever in the judgment of the Architect, Structural Engineer or the Authority having jurisdiction, such tests are necessary to determine the quality of the material. Test specimens for mortar and grout shall be made per ASTM C1586 and ASTM C

1019. In making the mortar test specimens the mortar shall be taken from the unit soon after spreading. After molding, the molds shall be carefully protected by a covering which shall be kept damp for at least 24 hours, after which the specimens shall be stored and tested as required for concrete cylinders. In making grout test specimens, the masonry unit molds shall be broken away after the grout has taken its set, but before it has hardened. If an absorbent paper liner is used the mold bay be left in place until the specimen has hardened. The prisms shall be stored as required for concrete cylinders. They shall be tested in the vertical position.

3. Masonry Core Tests: Not less than two cores having a diameter of approximately two-thirds of the wall thickness shall be taken from each project. At least one core shall be taken from each building for each four classrooms or equivalent area. The Architect or Structural Engineer in responsible charge of the project or his representative (inspector) shall select the areas for sampling. In the case of brick masonry one-half of the number of cores taken shall be tested in compression normal to the wall face and one-half shall be tested in shear. The shear loading shall test both joints between the grout core and the outside wythes of masonry. Core samples shall not be soaked before testing. Materials and workmanship shall be such that, for all masonry when tested in compression, cores shall show a strength of at least 1500 psi. When tested in shear the unit shear on cross section of the core shall not be less than 100 pounds per square inch. Visual examination of all cores shall be made to ascertain if the joints are filled. The school board inspector or testing agency shall inspect the coring of the masonry walls and shall prepare a report of coring operations for the testing laboratory files and mail one copy to the Building Department. Such reports shall include the total number of cores cut, the location, and the condition of all cores cut on each project regardless of whether or not the core specimens failed during cutting operation. All cores shall be submitted to the laboratory for examination.

3.7 ROOFING:

- A. Testing laboratory will conduct inspection and testing of built-up bituminous roofing as follows:
 1. Attend pre-roofing conference.
 2. Check deck surfaces prior to roofing application to verify that substrate is in satisfactory condition to receive roofing.
 3. Check kettle temperature control system and monitor kettle temperatures.
 4. Inspect and test materials including softening point of asphalt to ensure conformance with specifications.
 5. Check materials for excessive moisture.
 6. Observe roofing application techniques to ensure conformance with specification.

7. Supervise cutting and repair of cut-out tests and test and inspect cut-out samples for conformance with specifications.

3.8 GLUED LAMINATED LUMBER:

- A. Glued laminated lumber shall comply with California Code of Regulations, Title 24, Part 2, Sec. 2303.1.3 and Sec.1705.5.4. All structural glued laminated timber shall be continuously inspected during fabrication by an inspector approved for that purpose by the Division of the State Architect.
- B. Each structural glued laminated timber shall be stamped with an identification mark and shall be accompanied by a certificate of inspection. The certificate of inspection shall include pertinent data such as the grade and species of lumber, type of glue and such other information as may be required (refer to California Code of Regulations, Title 24, Part 2 - Sec. 1705.5.4. The certificate of inspection shall bear a signed statement by the inspector that the work has been done in conformance with the approved plans and specifications.
- C. The verified report, together with an identified copy of the lumber grade certificate shall be mailed to the Authority having jurisdiction upon completion of fabrication. An AITC Certificate will not meet this requirement.
- D. Exception: Special fabrication inspection is not required for noncustom members of 5 1/8 inch maximum width and 18 inch maximum depth, and with a clear span of 32 feet, manufactured and marked in accordance with ANSI/AITC A 190.0 Section 6.1.1 for noncustom members.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. Furnish and install all required temporary facilities as shown or specified herein plus such facilities as required for proper performance of the Contract. All such temporary facilities shall be located where directed and maintained in a safe and sanitary condition at all times until completion of the Contract. The Conditions of the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.

1.2 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Comply with governing regulations and utility company regulations and recommendations.
- B. Comply with pollutions and environmental protection regulations for use of water and energy, for discharge of wastes and storm drainage from project site, and for control of dust, air pollution and noise.
- C. Temporary work shall conform to all the requirements of State, County, and local authorities and underwriters which pertain to operation, health, safety, and fire hazard. Contractor shall furnish and install all items necessary for conformity with such requirements, whether or not called for under the separate divisions of these specifications.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TEMPORARY SANITARY FACILITIES:

- A. Provide temporary sanitary facilities in accordance with Article 44 of the General Conditions.

3.2 TEMPORARY ELECTRIC FACILITIES:

- A. Provide and maintain during the progress of the work all electrical lighting and power requirements to facilitate the work of all trades and services connected with the work. Lighting levels shall be adequate to permit workmen to properly perform their work, to permit detection of flaws in finishes, and to allow for reading of specifications.
- B. Provide temporary electricity in accordance with Article 43 of the General Conditions.

3.3 TEMPORARY WATER:

- A. Provide for all water required for construction purposes and for testing, disinfection and flushing of the water supply system. Furnish and install piping or hose to carry water to every point where needed on the project. All water used on the project shall be potable water. Closest availability of water shall be determined by the Contractor.
- B. Provide temporary water in accordance with Article 43 of the General Conditions.

3.4 TEMPORARY HEATING AND VENTILATING:

- A. Provide all temporary heat as necessary for the drying out of the building, the proper installation of all work and materials, and the protection of all work and materials against injury from dampness and cold. The permanent building heating system shall not be used for any temporary heating unless first approved by the Architect. If approved for use, filters shall be replaced before final acceptance of the work.
- B. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.
- C. Provide temporary gas, if required, in accordance with Article 43 of the General Conditions.

3.5 CONSTRUCTION EQUIPMENT:

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

3.6 FENCES AND BARRICADES:

- A. Prior to start of work at the project site, install a 6 foot high chain link fence or solid plywood and wood frame enclosure fence with locked entrance gates. Locate the fence to enclose substantially the entire project site, or that portion the Contractor establishes as required to encompass the entire project construction operation.
- B. Construct and maintain planking, barricades, lights, and warning signs as required by local authorities and State safety ordinances, and as necessary for the protection of the public. Provide walks around obstructions made in a public place for carrying on the

work covered in this contract. Leave protection in place and maintain in good condition until removal is authorized.

- C. Provide barriers to protect trees and plants on the site and immediately adjacent to the site which are designated to remain. Construct temporary barriers to a height of 6 feet around each tree or plant or each group of trees or plants.

3.7 STORAGE:

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

3.8 TEMPORARY JOB OFFICE:

- A. Contractor shall provide and maintain, in good condition, on the site a temporary job office of suitable size for himself and for project meetings. Job office shall be weatherproof and secure and shall be provided with adequate lighting, heat, and ventilation. The meeting area shall be furnished with a conference table and sufficient chairs for all participants. Provide plan rack and files for storage of project record documents.

3.9 TEMPORARY OFFICE FOR OWNERS INSPECTOR:

- A. Provide temporary office for Owner's inspector in accordance with Article 41 of the General Conditions.

3.10 PROJECT SIGN:

- A. Provide one painted sign not less than 96 square feet in area with painted graphic content to include project title and the names and titles of the Owner, Architect, Professional Consultants, Prime Contractor, and Major Subcontractors involved. Graphic design, style of lettering and colors shall be as selected by the Architect. No other advertising will be permitted at the project site.
- B. Paint all exposed surfaces of sign including supports and framing with one coat of primer and one coat of exterior paint. Painting of graphics shall be by a professional sign painter.
- C. Install the sign on the site at a location of high public visibility as approved.

3.11 REMOVAL AT COMPLETION:

- A. Upon completion of the work, or prior thereto, when so directed by the Architect, Contractor shall remove all temporary facilities, structures and installation from the Owner's property. Similarly, return exterior areas utilized for temporary facilities to substantially their original state, or when called for on the drawings, complete the areas as shown or noted. Sanitary facilities shall be properly disinfected and evidence of same removed from the site.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY OF THE WORK:

- A. The work includes performing all operations in connection with construction surveying requirements for the work of this project as specified herein. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 RELATED SECTIONS

- A. 01 11 00 – Scope of Work.
- B. 01 31 19 - Project Meetings
- C. 01 77 00 - Contract Closeout

1.3 GENERAL:

- A. CONTRACTOR shall employ a State of California licensed surveyor to lay out the entire Work, set grades, lines, levels, control points, vertical and horizontal control, elevations, grids and positions.

1.4 SUBMITTALS

- A. CONTRACTOR shall submit the name and address of the State of California licensed surveyor to ARCHITECT and DISTRICT, including any changes as they may occur.
- B. At request of ARCHITECT and/or DISTRICT, CONTRACTOR shall submit copies of cut sheets, coordinate plots, data collector printouts, and other documentation as available to verify completeness and/or accuracy of field surveying Work

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

3.1 LAYOUT OF THE WORK

- A. Before the commencement of Work, surveyor shall, in conjunction with the DISTRICT-provided engineering survey of the Project site, locate all reference points and benchmarks, then lay out all lines, elevations, and measurements for the entire Work, including but not limited to, buildings, grading, paving and utilities.

3.2 SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent horizontal and vertical control points on the Project site, remote from the building area, referenced to data established by the survey control points.
 - 1. Indicate the reference points on the project record drawings with the basis of elevation being the established benchmarks.
- B. Establish lines, grades, locations and dimensions by instrumentation. Periodically, verify the layout of all Work by the same methods.
 - 1. Provide grade stakes and elevations for over-excavation and re-compaction, rough and final grades, paved areas, curbs, gutters, sidewalks, building pads, landscaped areas, and other areas as required.
 - 2. Calculate and layout proposed finished elevations and intermediate control as required to provide smooth transitions between the spot elevations indicated in the Contract Documents.
 - 3. Provide stakes and elevations for grading, fill, and topsoil placement.
- C. Provide adequate horizontal and vertical control to locate utility lines, including but not limited to, storm drains, sewers, water mains, gas, electric and signal, and provide vertical control in proportion to the slope of the line as required for accurate construction.
 - 1. Prior to trench closure, survey and record locations and invert and flow line elevations at manholes, POCs, and 50-foot intervals.
- D. Survey and record top of curb and flow line elevations on finished concrete or AC surfaces at key locations such as BC's, EC's, grade breaks, corners or angle points in sufficient number to demonstrate the Work complies with the intent of the Contract Documents.
- E. Provide horizontal and vertical control for batter boards for drainage, utility, and other on-site structures as required.
- F. Furnish building corner offsets as required to adequately locate building pads. Provide cut and fill stakes within the building pad perimeter adequate to control both over excavation and re-compaction and the final sub-grade elevation of the building pad.
- G. Submit a certification signed by the surveyor confirming that the elevations and locations of improvements are in conformance with the Contract Documents. The statement shall include survey notes for the finish floor and building pad, showing the actual measured elevations on the completed sub-grade, recorded to the nearest 0.01'. Building pad tolerance will be $\pm 0.10'$.

3.3 RECORD DRAWINGS

- A. The surveyor shall record all horizontal and vertical control information on “as-built” Record Drawings, as coordinates and elevations. Record drawings shall indicate locations of all utilities information, as described above.
- B. Upon Substantial Completion, CONTRACTOR shall deliver to the ARCHITECT reproducible transparencies of the final Record Drawings.
- C. Completed record drawing transparencies shall be signed by the licensed surveyor, certifying that the information shown is correct and is in conformance with the Contract Documents within specified tolerances.
- D. Where other sections of the Contract Documents require verification or measurements of installed Work by survey, the surveyor shall perform and certify that all such surveys or verifications are completed in accordance with the Contract Documents.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing and installing of cutting and patching as necessitated by the work described in the drawings and the sections of this specification. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 SUBMITTALS:

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of the 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.
- B. Include in request:
 - 1. Identification of project.
 - 2. Location and description of affected work.
 - 3. Necessity for cutting or alteration.
 - 4. Alternatives to cutting and patching.
 - 5. Description of proposed work and products to be used.
 - 6. Effect on work of Owner or separate Contractor.
 - 7. Written permission of affected Contractor

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Primary Products: Those required for original installation, unless specifically approved otherwise.

PART 3 - EXECUTION

3.1 EXAMINATION:

- 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. 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, Contractor shall prepare detailed drawings for review by the Architect and approved by the DSA.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION:

- A. Provide temporary support to ensure structural integrity of the work. Provide devices and methods to protect other portions of the project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work.
- C. Maintain excavations free of water.
- D. Where the work requires sandblasting or existing surfaces in order to receive new materials secured by cementitious, adhesive or chemical bond, completely remove existing finishes, stains, oil, grease, bitumen, mastic and adhesives or other substances deleterious to the new bonding and/or fastening of the new work. Utilize wet sandblasting for interior surfaces and for exterior surfaces where to prevent objectionable production of dust.

3.3 PERFORMANCE:

- A. General: The word “cutting” as used in the Contract Documents includes, but is not limited to, cutting, drilling, chopping, and other similar operations and the word “patching” includes, but is not limited to, patching, rebuilding, reinforcing, repairing, refurbishing, restoring, replacing or other similar operations. Unless indicated otherwise on the drawings, perform all cutting and patching as indicated below.
- B. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Carefully remove existing work to be salvaged and/or reinstalled. Protect and store for reuse in the work. Verify compatibility and suitability of existing substrates before starting the work.

- C. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining work. Where possible, review proposed procedures with the original installer and comply with original installer's recommendations.
1. Where cutting, use hand or small power tools designed for sawing or grinding, not hammering or chopping. Cut holes and slots as small as possible, neatly to size required and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine, such as a carborundum saw or a diamond-core drill. Saw cut reinforcing bars and paint ends with bituminous paint except where bonded into concrete or masonry.
 4. Concrete site paving: Cut and remove entire panels to nearest joint.
 5. Woodwork: Cut and or remove to a panel or joint line.
 6. Sheet Metal: Remove back to a panel or joint line. Secure loose or unfastened ends or edges and seal watertight.
 7. Glass: Remove cracked, broken or damaged glass and clean rabbets and stops of setting materials.
 8. Plaster: Cut back to sound plaster on straight line, and back bevel edges or remaining plaster. Trim existing lath and prepare for new lath.
 9. Gypsum Wallboard: Cut back on straight line to undamaged surfaces with at least two opposite cut edges centered on supports.
 10. Acoustical Ceilings: Remove hanger wires and related appurtenances where ceilings are not scheduled to be installed.
 11. Tile: Cut back to sound tile and backing on joint lines.
 12. Flooring: Completely remove flooring and clean backing of prior adhesive. Carefully remove wood flooring for patching and repairing of existing wood flooring shown to remain.
- D. Patching: Patch with durable seams that are as invisible as possible. Comply with required tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation. Verify conditions of existing substrates prior to executing work.

2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate all evidence of patching and refinishing.
3. Concrete: Maintain cut edges in a moist condition for twenty-four hours prior to the placement of new concrete. In lieu of this, an epoxy adhesive may be provided. Finish placed concrete to match existing unless noted otherwise. Concrete shall have a compressive strength of 3,000 psi where installed to repair and/or match existing improvements, unless noted otherwise.
4. Trench backfill and compaction is required prior to patching concrete and asphalt site paving. All trenches shall be backfilled above utilities and/or encasement to the bottom of pavement section or within 12" of finished grade with damp sand, placed in 6-inch layers and compacted to minimum relative density of 90 percent. Attain compaction by any method (other than water jetting) that will obtain the minimum specified relative densities, without damaging the buried lines.
 - a. If trenching occurs in landscaped area, remainder of backfill shall be native soils having no stones or aggregate greater than 3 inches diameter. Native soils in landscape areas shall be compacted to minimum relative density 80 percent.
5. Metal Fabrications: Items to remain exposed shall have their edges cut and ground smooth and rounded.
6. Sheet Metal: Replace removed or damaged sheet metal items as required for new work.
7. Glass: Install matching glass and re-seal exterior window assemblies.
8. Lath and Plaster: Install new lath materials to match existing and fasten to supports at 6 inch on center. Provide a 6 inch lap where new lath adjoins to existing lath. Fasten new lath as required for new work. Restore paper backing as required to provide moisture protection. Apply a bonding agent on cut edges of existing plaster. Apply three-coat plaster of the type, thickness, finish and color to match existing.
9. Gypsum Wallboard: Fasten cut edges of wallboard. Install patches with at least two opposite edges centered on supports and secure at 6 inches on center. Tape and finish joints and fastener heads. Patching shall be non-apparent when painted and/or finished.
10. Acoustical Ceilings: Comply with the requirements for new work specified in related sections of the contract documents.
11. Resilient Flooring: Completely remove flooring and prepare substrate for new material.

12. Ceramic Tile: Install new ceramic tile to match adjacent installation. Use full tiles with grout joints of same size. Color of tile shall approximate that of adjacent surfaces. Where color does not match, obtain direction from the Architect prior to proceeding.
 13. Paint: All patched areas where adjacent surfaces are painted, shall be prepared and painted to match per Section 09 90 00. Entire surfaces where patches occur shall be painted. Painting shall occur from joint-to-joint, or corner-to-corner.
- E. Fit work air tight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
 - F. At penetrations of fire-rated walls, partitions, ceiling or floor construction, completely seal voids with fire-rated devices or materials in accordance with Section 07 84 00.
 - G. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For and assembly, refinish entire unit.

3.4 SLEEVES AND HANGERS:

- A. Provide conduit, outlets, piping sleeves, boxes, inserts or other materials, or equipment necessary to be built into the work.
- B. Upon subsequent installation of sleeves or other material, install fill materials to completely seal voids with fire-rated devices or moisture-resistant material, to full thickness of the penetrated element. Necessary expenditures incurred for boxing out or filling shall be without extra cost to the Owner.

3.5 QUALITY CONTROL:

- A. Do not backfill underground utility lines until:
 1. The "As-Built" elevations and dimensions are recorded on "Record Drawings" and verified.
 2. The utility lines have been inspected and satisfactorily tested.
- B. Backfill compaction tests will be performed by the Owner's Geotechnical Engineer, in accordance with Section 01 45 00, at locations and depths as directed. If the required minimum relative compaction density has not been obtained, excavate and re-backfill the deficient portion of the trench.

3.6 CLEANUP:

- A. Pick up and transport unsuitable and deleterious material to an off-site legal disposal area. Place acceptable excess earth in on-site areas as compacted fill.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section specifies diversion of Construction and Demolition (C&D) waste from the landfill.
 - 1. Waste Management Goals: a minimum of 65% of the total project waste should be diverted from landfill, in order of preference 1) weight, 2) volume, whichever is most feasible to measure.
 - 2. Provide contract documents, including a waste management plan, to show evidence of recycling, and reuse of recovered materials.
 - 3. Inform Owner and architect where Construction and Demolition (C&D) Waste Management requirements could detrimentally impact C&D schedule.
 - 4. Provide separate itemization of cost related to C&D Waste Management.
 - 5. Effect optimum management of solid wastes via a materials management hierarchy.
 - 6. The materials management hierarchy shall be: reduce, reuse, and recycle.
 - 7. Prevent environmental pollution and damage.
- B. Related Documents:
 - 1. 01 77 00 - Contract Closeout and Final Cleaning.
 - 2. Document Number - Hazardous Materials Procedures.
 - 3. Document Number - Hazardous Materials Management – Asbestos.
 - 4. Document Number - Hazardous Materials Management – Lead.
 - 5. Document Number - Hazardous Materials Management – PCB.
 - 6. Document Number - Hazardous Materials Management – Hazardous Metals.
 - 7. Document Number - Hazardous Materials Management – Mercury.

1.2 DEFINITIONS:

- A. Inert Fill – A permitted facility that accepts inert waste such as asphalt and concrete exclusively.

- B. Class III Landfill - A landfill that accepts non-hazardous waste such as household, commercial, and industrial waste, including construction, remodeling, repair, and demolition operations.
- C. Construction and Demolition Waste – Including solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair, and demolition operations.
 - 1. Rubbish: Including both combustible and noncombustible wastes, such as paper, boxes, glass, crockery, metal and lumber scrap, tin cans, and bones.
 - 2. Debris: Including both combustible and noncombustible wastes, such as leaves and tree trimmings that result from construction or maintenance and repair work.
- D. Deconstruction - The process of removing existing building materials from renovation and demolition projects for the purposes of reuse, and recycling, in a efficient and safe manner possible.
- E. Divert – Using material for any purpose other than disposal in a landfill.
- F. Waste Materials – Large and small pieces of listed materials which are excess to contract requirements and generally include materials to be recycled and/or recovered from existing construction and items of trimmings, cuttings, and damaged goods resulting from new installations, which can be effectively used in the Work.
- G. Reuse – Using a material or product that is recovered from construction, renovation, or demolition activities.
- H. Recycling – The process of collecting and preparing recyclable materials in their original form or in manufacturing processes that do not cause the destruction/contamination of recyclable materials in a manner that precludes further use.
- I. Recovery – Any process that reclaims materials, substances, energy, or other products contained within or derived from waste on-site. It includes waste-to-energy, composting, and other processes.
- J. Sources Separation – Sorting the recovered materials into specific material types with no or a minimum amount of contamination on site.
- K. Time-Based Separation – Collecting waste during each phase of construction or deconstruction which results in primarily one major type of recovered material. The material is removed before it becomes mixed with the material from the next phase of construction.
- L. Commingled or Off-site Separation – Collecting all material types into a single bin or mixed collection system and separating the waste materials into recyclable material types in an off-site facility.

1.3 SUBMITTALS:

- A. C&D Waste Management Plan: Before the start of demolition, submit a C&D waste management plan to the Owner and the architect for approval and it shall include the following:
1. Indicate how the Contractor proposes to recover at least 65% of the C&D wastes for reuse and recycling.
 2. The C&D Waste Management Plan should coordinate the recovery effort with the construction, and renovation / demolition schedule.
 3. Indicate compliance with section 1.5 QUALITY ASSURANCE.
 4. Include a list of reuse facilities, recycling facilities and processing facilities that will be receiving the recovered materials (including take back by Owner or on-site auctions.)
 5. If some of the materials will be donated or sold on-site auctions, describe the process and identify the organizations that may receive the materials.
 6. Identify materials that are not recyclable or not recovered which will be disposed of in a landfill (or other means acceptable by the State of California and local ordinance and regulations) and explain why the materials are not recovered.
 7. List the permitted landfill, or other permitted disposal facilities, that will be accepting the disposed waste materials.
 8. Indicate instances or situations where compliance with the requirements of this specification do not apply or do not appear to be possible.
 9. Identify each type of waste material to be reused or recycled and estimate the amount, by weight.
 10. Provide estimate of time requirements for demolition and for the removal of valuable reusable items and materials.
 11. Prepare building engineering survey and worker safety plan, assessment of building condition and all potential hazards.
 12. Provide a C&D site management plan.
 13. Provide final accounting of disposition of recovered materials upon completion of project for final payments.
- B. C&D Waste Management Summary Reports: Provide the C&D Quality Manager with delivery receipts for the recovered materials and waste materials sent to the permitted recycling facilities, processing facilities, or landfill with the following information:
1. Name of firm accepting the recovered materials or waste materials

2. Specify type of facility (e.g. retail facility, recycler, processor, Class III landfill, MRF)
 3. Location of the facility
 4. Type of materials
 5. Net weights (or volume) of each type of material
 6. Date of delivery
 7. Value of the materials or tipping fee paid
- C. Application for Progress Payment: The following should be submitted with the Application for Progress Payment:
1. C&D Waste Management Summary Report as stated above in section 1.3 SUBMITTALS, B. C&D Waste Management Summary Reports, with the C&D Quality Manager approval on each of the report.
 2. Prepare 3-ring binder with rebate information and product documentation as required for Owner to qualify for rebate program; submit binder with final closeout submittals.
 3. Payment could be withheld until diversion goals are met. The Contractor is ultimately responsible for implementation of the C&D Waste Management Plan and achieving the diversion goals.

1.4 RECYCLING PROGRAM:

- A. The recycling program could utilize one or a combination of any of the following common waste diversion strategies:
1. Sources Separation
 2. Time-Based Separation
 3. Commingled or Off-site Separation
 4. Back haul of packaging
 5. On-site sales auctions and removal.
- B. Waste Material management hierarchy can be viewed as: reuse on-site, recycle on-site, reuse off-site, and recycle off-site.
- C. Other innovative approaches to achieve the minimum diversion rate are encouraged and should be specified and described in the C&D Waste Management Plan.
- D. Minimum diversion rate may be achieved by recovering and recycling the following materials: *[Edit to suit project.]*

1. Asphalt
2. Concrete and concrete blocks
3. Brick, tile and masonry materials
4. Ferrous metal
5. Non-ferrous metals: copper, aluminum ... etc
6. Untreated lumber
7. Plywood, OSB and particle board
8. Gypsum wallboard scrap
9. Paper and cardboard
10. Beverage containers
11. Insulation
12. Rigid foam
13. Glass
14. Carpet and pad
15. Trees and shrubs
16. Soil
17. Plumbing fixtures
18. Windows
19. Doors
20. Cabinets
21. Architectural fixtures
22. Millwork, paneling and other similar interior finishes
23. Electric fixtures, motors, switch gear and other similar equipment
24. HVAC equipment, duct work, control systems, switches and other similar equipment
25. Others as appropriate

1.5 QUALITY ASSURANCE:

- A. Regulatory Requirements: Comply with applicable requirements of the State of California, local ordinances and regulations concerning management of construction, clearing, and inert materials.
 - 1. CCR Title 24 Part 11, California Green Building Standards
- B. Disposal Site, Recyclers and Waste Materials Processors: Use only facilities properly permitted by the State of California, and/or by local authorities where applicable.
- C. Pre-C&D Waste Management Meeting: Prior to beginning work at the site, schedule and conduct a meeting to review the C&D Waste Management Plan and discuss procedures, schedules, coordination and specific requirements for waste materials recycling and disposal. Discuss coordination and interface between Contractor, sub-contractors, architect, engineers, project manager, Owner, and other C&D activities. Identify and resolve problems of compliance with requirements. Record minutes of the meeting, identifying conclusions reached and matters requiring further resolution. Maintain waste management as an agenda item at future construction meetings.
 - 1. Attendees: Contractor and related contractor personnel associated with work of this section, including personnel in charge of the waste management program; C&D Quality Manager; architect; engineers; material and equipment suppliers where appropriate; and such additional Owner personnel as Owner deems appropriate.
 - 2. Plan Revision: Make revisions to C&D Waste Management Plan agreed upon during the meeting and incorporate resolutions agreed to be made subsequent to the meeting. Submit revised plan to architect or the Owner personnel as Owner deems appropriate for approval.
- D. Implementation:
 - 1. Designate an on-site party responsible for instructing workers and implementing the C&D Waste Management Plan.
 - 2. Distribute copies of C&D Waste Management Plan to job site foreman and each subcontractor.
 - 3. Include waste management and recycling in worker orientation.
 - 4. Provide on-site instruction on appropriate separation, handling, recycling, and recovery methods to be used by all parties at the appropriate stages of the work at the site.
 - 5. Also include discussion of waste management and recycling in regular job meeting and job safety meetings conducted during the course of work at the site.
- E. The Contractor will be responsible for ensuring that the appropriate governmental entities are notified of the work.

- F. Remove and relocate reusable materials to be reinstalled or retained in a manner to prevent damage or contamination.
- G. Conduct construction and demolition in such a manner to minimize damage to trees, plants and natural landscape environment.
- H. Arrange for adequate collection, and transportation to deliver the recovered materials to the approved recycling center or processing facility. Maintain records accessible to the architect or C&D Quality Manager for verification of diversion of recovered waste materials.

1.6 STORAGE AND HANDLING:

A. Site Storage:

- 1. Remove materials for recycling and recovery from the work locations to approved containers or storage area as required. Failure to remove waste or recovered materials will be considered cause for withholding payment and termination of Contract.
- 2. Position containers for recyclable and recoverable waste materials at a designated location on the Project Site. If materials are sorted on site, also provide a sorting area and necessary storage containers.
- 3. Change-out loaded containers for empty containers, as demand requires.
- 4. If recovered materials are stored on-site for project duration provide adequate security from pilferage.

B. Handling

- 1. Deposit indicated recyclable, and recoverable materials in storage areas or containers in a clean (no mud, adhesive, solvents, petroleum contamination), debris-free condition. Do not deposit contaminated materials into the containers until such time as such materials have been cleaned.
- 2. Ensure all recovered materials are made safe for handling and storage.
- 3. If the contamination chemically combines with the material so that it cannot be cleaned, do not deposit into the recycle containers. In such case, request resolution by the C&D Quality Manager for disposal of the contaminated material. Directions from the C&D Quality Manager do not relieve the Contractor of responsibility for compliance with all legal and regulatory requirements for disposal, nor shall such directions cause a request for modification of the Contract.

1.7 PROJECT CONDITIONS:

A. Environmental Requirements:

1. Transport recyclable and recoverable waste materials from the Work Area to containers and carefully deposit in the containers without excess noise and interference with other activities, to minimize noise and dust.
2. The Contractor shall ensure adequate erosion control and storm water control, if required, to prevent or minimize the negative impact to its surrounding environment.
3. Provide measures to ensure the containment of lead-based paint and dust, nails, asbestos-based products and any biological contaminants that may affect environmental health and safety conditions.

B. Site Condition:

1. Signs and instructions should be clear, and easy to understand. All recycling containers should be clearly labeled and lists of acceptable and unacceptable materials will be posted throughout the site. Whenever possible, they should be in multiple-languages, especially in Spanish, and in graphic symbols.
2. The Contractor shall ensure the safety of all personnel involved in the C&D process.
3. A C&D site management plan shall be created including: work areas, materials processing areas, materials storage and disposal areas, worker hand-washing and changing stations, first aid and medical information.

PART 2 - PRODUCTS

2.1 SALVAGED AND REUSE MATERIALS:

A. The following components and fixtures are collected for reuse *[Edit to suit project]:*

1. Plumbing fixtures
2. Windows
3. Doors
4. Cabinets
5. Bricks
6. Millwork, paneling and other similar interior finishes
7. Electric fixtures, motors, switch gear and other similar equipment
8. HVAC equipment, duct work, control systems, switches and other similar equipment
9. Architectural fixtures

10. Others as appropriate

B. Wood collected for reuse is sorted by: *[Edit to suit project]*:

1. Type

2. Size, dimension

3. Protected from the ground, bending, and moisture

2.2 RECYCLED MATERIALS:

A. The following materials are collected for recycling *[Edit to suit project]*:

1. Asphalt

2. Concrete and concrete blocks

3. Tile and masonry materials

4. Ferrous metal

5. Non-ferrous metals: copper, aluminum ... etc

6. Untreated lumber

7. Plywood, OSB and particle board

8. Gypsum wallboard scrap

9. Paper and cardboard

10. Beverage containers

11. Insulation

12. Rigid foam

13. Glass

14. Carpet and pad

15. Trees and shrubs

16. Soil

PART 3 - EXECUTION (N/A)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing of all labor, materials, equipment, and services, and performing all operations necessary for, and properly incidental to, cleanup during construction and final cleaning of the building prior to acceptance by the Owner, including waxing and polishing as specified herein and in other sections when specified. The Conditions of the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Use only cleaning materials which will not create hazards to health or property and which will not damage materials. Use only cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned. Use cleaning materials only on surfaces recommended by the cleaning material manufacturer.

PART 3 - EXECUTION

3.1 CLEANUP DURING CONSTRUCTION:

- A. It is required that the entire site be kept in a neat and orderly condition, and the Architect may, at any time during construction, order a general cleanup of the site as a part of the work under this section.
- B. Dispose of waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris on the site will not be permitted.
- C. Location of dump for trash and debris and length of haul is the Contractor's responsibility.

3.2 FINAL CLEANING OF BUILDING:

- A. Prior to final inspection by the Architect and after all construction work is essentially complete, thoroughly clean the building, utilizing professional building cleaners. Items to be cleaned include, but are not limited to; all glass, plastic, doors, opening frames, grilles, trim, exposed non-ferrous metal surfaces, floor covering, light fixtures and plates, plumbing fixtures and trim, and all finish surfaces throughout the construction. Thoroughly remove ink trademarks from laminated plastic surfaces. Vacuum-clean the

building and remove all spots, smears, dust, debris, handprints and defacements of every sort, including those of vandals. Follow the recommendations of the manufacturer of the materials and items to be cleaned for all cleaning, polishing, and treatment such as waxing.

3.3 FINAL SITE CLEANUP:

- A. Also prior to final inspection, thoroughly clean the entire site and put it into a neat, acceptable condition. Remove from the entire site all construction waste and unused materials, dunnage, loose rock and stones, excess earth, roots, weeds, and all debris of any description resulting from the work. Hose down and scrub where necessary all new concrete and asphalt pavement and walks dirtied as a result of the work. Thoroughly remove mortar droppings from concrete walks and other pavements.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes performing all operations necessary for and properly incidental to closing out the project and assisting in Owner's final inspection as hereinafter specified. The Conditions of the Contract and the other sections of Division 1 apply to this section as fully as if repeated herein.

1.2 REQUIREMENTS PREPARATORY TO FINAL INSPECTION:

- A. All temporary facilities shall be removed from the site as specified in Section 01 50 00.
- B. The building and site shall be thoroughly cleaned as specified in Section 01 74 23.
- C. All plumbing and mechanical equipment shall operated quietly and free from vibration. Properly adjust, repair, balance, ore replace equipment producing objectionable noise or vibration in the occupied areas of the building. Provide additional brackets, bracing, other methods to prevent objectionable noise or vibration. All systems shall operate without humming, surging, or rapid cycling.
- D. All operating instructions for equipment shall be properly mounted and posted as specified in their respective sections.
- E. Record (As-built) drawings shall be completed, signed, and submitted to the Architect as specified under Article 1.4 of this section.
- F. The Material and Equipment maintenance instructions, as specified in the body of the Specifications, shall be submitted to the Architect.
- G. All guarantees and warranties shall be submitted to the Architect as specified in the General Conditions.

1.3 FINAL INSPECTION:

- A. After all requirements preparatory to the final inspection have been completed as hereinbefore specified, Contractor shall notify the Architect to perform the final inspection. Notice shall be given at least three (3) working days in advance of the time the final inspection is to be performed.
- B. The Contractor or his principal superintendent, authorized to act in behalf of the Contractor, shall accompany the Architect and Owner on the final inspection tour, as well as principal subcontractors that the Architect or Owner may request to be present.

- C. If the work has been completed in accordance with the Contract Documents, and no further corrective measures are required, the Owner will accept the Project and will file for the Notice of Completion.
- D. If the work has been substantially completed in accordance with the Contract Documents, and only minor corrective measures are required, the Architect will prepare a punch list of work to be corrected and the Owner will conditionally accept the Project and will file for the Notice of Completion based upon the Contractor's assurance that the corrective measures will be completed within the shortest practicable time period.
- E. If the work has not been substantially completed in accordance with the Contract Documents, and several corrective measures are still required, the Owner will not accept the Project or file for the Notice of Completion. Instead, a punch list will be prepared, based on the information gathered from the final inspection, and the Contractor will be required to complete this work and then call for another final inspection, following the procedure outlined above.
- F. Upon acceptance of the Project by the Owner, Contractor shall submit his request for the final and acceptance payment. Final payment will not be made by the Owner, however, until thirty-five (35) days after filing for the Notice of Completion.

1.4 RECORD DRAWINGS (AS-BUILT DRAWINGS):

- A. The Contractor shall provide Record Drawings which shall clearly show all differences between the contract work as drawn and as installed for all concealed work, as well as work added to the contract which is not shown on the Contract Drawings.
- B. Concealed shall mean work installed underground or in an area which cannot be readily inspected by use of access panels, inspection plates or other removable features.
- C. The Contractor shall maintain a set of Record Drawings at the job site. These shall be kept current and legible and shall be available for inspection at all times by the Architect. Show all changes in the contract work, or work added on the Record Drawings in a contrasting color.
- D. At the conclusion of work, the Contractor shall provide one (1) USB drive with electronic files of the Record Drawings and the Operations and Maintenance Manuals (pdf format). Additionally, provide one (1) complete set of Operations and Maintenance Manuals in a 3-ring binder. If multiple buildings are within a project, provide separate manuals for each building. Each building should be identified on the binders.
- E. In showing changes in the work, or added work, use the same legends that are used on the Contract Drawings. Indicate exact locations by dimensions and exact elevations. Give dimensions from a permanent reference point. Prepare all changes to scale.

1.5 OPERATION AND MAINTENANCE DATA SUBMITTAL:

- A. As outlined above (1.4D), data shall be submitted a minimum of thirty (30) days prior to completion of the contract. The contract shall not be considered complete until this data has been reviewed by the Owner.
- B. Assemble all data required herein, except that to be mounted in frames, in three-ring loose-leaf binders, complete with index, index dividers, and permanently attached exterior label on cover.
- C. Data Required:
 - 1. Manufacturer's Manuals: Complete installation, operation, maintenance and service manuals, and printed instructions and parts lists for all materials and equipment where such printed matter is regularly available from the manufacturer. This includes but is not limited to such service manuals as may be sold by the manufacturer covering the operation and maintenance of his items, and complete replacement parts lists sufficiently detailed for parts replacement ordering to manufacturer. Bound publications need not be assembled in binders.
 - 2. Equipment Nameplate Data: A typewritten list of all mechanical and electrical equipment showing all equipment nameplate data exactly. Identify equipment by means of names, symbols, and numbers used in the contract documents.
 - 3. System Operating Instructions: Typewritten instructions covering operation of the entire system as installed (not duplicating manufacturer's instructions for operating individual components). Include schematic flow and control diagrams as appropriate and show or list system valves, control elements, and equipment components using identification symbols and numbers. List rooms, area of equipment served, and show proper settings for valves, controls, and switches.
 - 4. System Maintenance Instructions: Typewritten instructions covering routine maintenance of system. List each item of equipment requiring inspection, lubrication, or service and briefly describe such maintenance, including types of lubricants and frequency of service. It is not intended that these instructions duplicate manufacturer's detailed instructions. Give name, address and phone number of nearest firm authorized or qualified to service equipment or provide parts.
 - 5. Wall-Mounted Data: Frame one set of typewritten system instructions and diagrams as required under Paragraphs .3 and .4 above, covered with glass and mounted in locations as directed by the Owner. This set of instructions is in addition to the five required hereinbefore.

1.6 INSTRUCTION OF OWNER'S MAINTENANCE PERSONNEL BY THE CONTRACTOR:

- A. After work under this contract is completed, tested and prior to acceptance, and not less than five (5) days after submittal of the operation and maintenance data required in Paragraph 2.6, the Contractor shall operate all systems for a period of three 8-hour days

during which time he shall keep on the project a competent man or men familiar with the items installed whose full-time assignment will be to instruct the Owner's maintenance personnel in the operating and maintenance of the equipment and systems.

- B. Any instructions from manufacturer's representatives required under other sections of this specification shall be conducted during this period. This instruction period shall not be conducted prior to completion of all piping and equipment labeling required by the contract.
- C. All arrangements and notices for operation and instruction periods shall be made through the Owner.
- D. This three-day instruction period shall be in addition and subsequent to any period of operation, test and adjustment called for elsewhere in this specification.

1.7 MANUFACTURERS' WARRANTIES:

- A. Deliver all the manufacturers' warranties required by the Contract Documents, with Owner named as the beneficiary. In addition, for all equipment and machinery, or components thereof, bearing a manufacturers' warranty that extends for a longer time period than the Contractor's warranty, secure and deliver the manufacturers' warranties in the same manner.
- B. Form of Warranty: Written warranties, except manufacturers' standard printed warranties, shall be on the Contractor's, subcontractor's, material supplier's, or manufacturer's own letterhead, addressed to the Owner. All warranties shall be submitted in duplicate, and in the form shown on the following page, modified as approved to suite the conditions pertaining to the warranty.
- C. Submission of Warranties: Collect and assemble all written warranties into a bound booklet form and deliver them to the Owner's Counsel for final review and approval.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes performing all operations in connection with demolition work as shown and noted on the drawings and as specified. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 STANDARDS:

- A. Except as modified by governing codes and regulations and the requirements specified herein or details on the drawings, demolition work shall conform to the following standards:
- B. Safety Code for Building Construction ANSI A.10.2

PART 2 - SPECIAL CONSIDERATIONS

2.1 SCHEDULING:

- A. Before commencing any alteration or demolition work, submit for review by the Architect and approval by the Owner, a schedule showing the commencement date, the order, and the completion dates for the various parts of work.
- B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the existing building or adjoining facilities, notify the Architect and Owner 72 hours in advance and obtain the Owner's approval in writing before proceeding with this phase of the work.

2.2 PROTECTION:

- A. Make such explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. Give particular attention to shoring and bracing requirements so as to prevent any damage to existing construction.
- B. Provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs, and other items as required for proper protection of the workmen engaged in demolition operations, occupants of the building, public and adjacent construction.
- C. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by permanent work.

- D. Provide and maintain temporary protection of the existing structure designated to remain where demolition, removal, and new work is being done, connections made, materials handled, or equipment moved.
- E. Take necessary precautions to prevent dust and dirt from rising by wetting demolished masonry, concrete, plaster, and similar debris. Protect unaltered portions of the existing building affected by the operations under this section by dustproof partitions and other adequate means.
- F. Provide adequate fire protection in accordance with local fire department requirements.
- G. Do not close or obstruct exitways, walkways, passageways, or stairways without authorization of the Owner and local fire department. Do not store or place materials in passageways, stairs or other means of egress. Conduct operations with a minimum traffic interference.
- H. Be responsible for any damage to the existing structure or contents as a result of insufficient protection provided.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

- A. Demolition, removal, and alteration work shall be as shown on the drawings. Perform such work required with due care, including shoring, bracing, etc. Be responsible for any damage that may be caused by such work to any part or parts of existing structures or items designated for reuse. Perform patching, restoration, and sections of the specifications.
- B. Materials or items designated to become the property of the Owner shall be as shown on the drawings. Remove such items with care and store them in a location at the site to be designated by the Owner.
- C. Materials or items designated to be reinstalled shall be as shown on the drawings. Remove such items with care under the supervision of the trade responsible for reinstallation; protect and store until required. Replace material or items damaged in its removal with similar new material.
- D. Materials or items demolished and not designated to become the property of the owner or to be reinstalled shall become the property of the contractor and shall be removed from the owner's property.
- E. Execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building.
- F. In general, demolish existing work in small sections. Where necessary to prevent collapse of any construction, install temporary shores, struts, or bracing.

- G. Where alterations occur, cut, remove, patch repair, or refinish the adjacent surfaces or so much thereof as is required by the involved conditions, and leave in as good a condition as existed prior to the commencing of the work. The materials and workmanship employed in the alterations, unless otherwise shown or specified, shall be performed by the various respective trades that normally perform the particular items of work.
- H. Finish adjacent existing surfaces as specified for new work. Clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.
- I. Where existing equipment and/or fixtures are indicated to be reused, repair such equipment and/or fixtures and refinish to put in perfect working order. Refinish as directed.
- J. Cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
- K. Confine cutting of existing roof areas designated to remain to the limits required for the proper installation of the work. Cut and fold back existing built-up roofing. Cut and remove insulation, etc. Provide temporary weathertight protection as required until roofing and flashings are installed. Consult the Owner to ascertain if existing guarantee bonds are in force and execute the work so as not to invalidate such bonds.

3.2 NOISE CONTROL:

- A. All motorized equipment on the site, including hauling trucks, shall be equipped with sound control devices at all times. The sound level measured at a distance of 25 feet from any piece of equipment shall not exceed 60 decibels.
- B. Materials shall be lowered in fully enclosed chutes acoustically lined to maintain the sound level within the limits prescribed above.
- C. Workmen's voice communication shall be kept under control at all times.

3.3 CLEANING UP:

- A. Remove all debris as the work progresses. Maintain the premises in a neat and clean condition.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in-place concrete as indicated.
 - 2. Installation of items to be embedded in concrete, such as anchor bolts, inserts, embeds, and sleeves.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 35 42: CalGreen Requirements
 - 3. Section 03 20 00: Concrete Reinforcing.
 - 4. Section 03 30 00: Cast-In-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute (ACI) Publication:
 - 1. ACI 318 – Building Code Requirements for Structural Concrete, Chapter 6, Formwork, Embedded Pipes, and Construction Joints.
 - 2. ACI 347 – Guide to Formwork for Concrete.
- B. American Plywood Association (APA):
 - 1. Form No. V345 - Concrete Forming Design/Construction Guide.
- C. National Institute of Standards and Technology (NIST):
 - 1. NIST Voluntary Product Standard PS 1.

1.3 SUBMITTALS

- A. Submit detailed structural calculations and drawings approved and signed by a California registered Civil Engineer where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or where provision for vehicular traffic through falsework or shoring occurs. For all

other falsework and shoring submit layout signed by California registered Civil Engineer, manufacturer's authorized representative or a licensed contractor experienced in the usage and erection of falsework and vertical shoring. A copy of the plans and calculation shall be available at the jobsite at all times.

- B. Special Environmental Requirements Product Submittal Form, found in Appendix A of Section 01 35 43 Special Environmental Requirements. Provide the following information for all concrete formwork: 1. Local/Regional Materials.
- C. Shop Drawings: Submit Shop Drawings indicating locations of forms, construction and expansion joints, embedded items, and accessories.
- D. Product Data: Submit manufacturer's Product Data for form materials and accessories.

1.4 REGULATORY REQUIREMENTS

- A. California Building Code (CBC-SS/CC), Chapter 19A.
- B. California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Sections 1713 and 1717.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage shall prevent damage and permit access to materials for inspection and identification.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Form materials may be reused during progress of the Work provided they are completely cleaned and reconditioned, recoated for each use, capable of producing formwork of required quality, and are structurally sound.
- B. Form Lumber: WCLIB Construction Grade or Better, WWPA No. 1 or Better.
- C. Plywood: NIST Voluntary Product Standard PS 1, Group 1, Exterior Grade B-B Plyform or better, minimum 5-ply and 3/4 inch thick for exposed locations and at least 5/8 inch thick for unexposed locations, grade marked, not mill oiled. Furnished plywood with medium or high density overlay is permitted.
- D. Coated Form Plywood: For exposed painted concrete, plastic overlaid plywood of grade specified above, factory coated with a form coating and release agent Noxcrete", or equal.
- E. Tube Forms: Sonoco "Seamless Sonotubes," Ceme-Tube, Quik-Tube, or equal, of the type leaving no marks in concrete, one-piece lengths for required heights.

- F. Joist Forms: Code recognized steel or molded plastic types as required.
- G. Special Forms: For exposed integrally-colored concrete, plywood as above with high density overlay, plywood with integral structural hardboard facing or fibrous glass reinforced plastic facing, providing specified finish.
- H. For Exposed Concrete Finish:
 - 1. Plywood: New, waterproof, synthetic resin bonded, exterior type Douglas fir or Southern pine plywood manufactured especially for concrete formwork and conforming to NIST Voluntary Product Standard PS 1, Grade B-B grade, Class I.
 - 2. Glass-Fiber-Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surfaces.
 - 3. Steel: Minimum 16 gage sheet, well matched, tight fitting, stiffened to support weight of concrete, without deflection detrimental to tolerances and appearances of finished concrete surfaces.
 - 4. Plywood: "Finland Form,," "Combi Form" by North American Plywood Corporation, "Plyform" by Roy O. Martin, "ProForm" by Pacific Wood Laminates, or equal. The material shall be furnished with hard smooth birch face veneers with phenolic resin thermally fused onto panel sides. Edges shall be factory sealed.
- I. Form Ties: Prefabricated rod, flat band, wire, internally threaded disconnecting type, not leaving metal within 1 1/2-inch of concrete surface.
- J. Form Coating: Non-staining clear coating free from oil, silicone, wax, not grain-raising, "Formshield" by A.C. Horn, Inc., "Release" by Edoco/Dayton Superior, "Cast-Off" by Sonneborn/BASF Building Systems or equal. Where form liners are furnished, provide form coatings recommended by form liner manufacturer.
- K. Form Liner: Rigid or resilient type by L.M. Scofield, Symons, Greenstreak, or equal.
- L. Void Forms: Manufactured by SureVoid Products, Inc., Sonotube, Void Form International, or equal. Forms shall be "WallVoid" for temporary support of concrete walls and grade beams spanning between supports, and "SlabVoid" for creating gaps between concrete slabs or steps and underlying soils. Void forms shall be fabricated of corrugated paper with moisture resistant exterior, and shall be capable of withstanding working load of 1,500 psf. Provide accessories as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. Forms shall be constructed so as to shape final concrete structure conforming to shape, lines and dimensions of members required by Drawings and Specifications, and shall be sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be designed so that previously placed structures will not be damaged.
- B. Use form coating at all surfaces in contact with concrete.

3.2 TOLERANCES

- A. Permitted abrupt or gradual irregularities in formed surfaces as measured within a 5 feet length with a straightedge shall per ACI 347, Table 3.1:

Class of Surface			
A	B	C	D
1/8 inch	1/4 inch	1/2 inch	1 inch

- 1. Class A: Use for concrete surfaces prominently exposed to public view.
- 2. Class B: Use for coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
- 3. Class C: Use as a general standard for permanently exposed surfaces where other finishes are not specified.
- 4. Class D: Use for surfaces where roughness is not objectionable and will be permanently concealed.

3.3 ERECTION

- A. Plywood shall be installed with horizontal joints level, vertical joints plumb and with joints tight. Back joints by studs or solid blocking, and fill where necessary for smoothness. Reused plywood shall be thoroughly cleaned, damaged edges or surfaces repaired and both sides and edges oiled with colorless form oil. Nail plywood along edges, and to intermediate supports, with common wire nails spaced as necessary to maintain alignment and prevent warping.
- B. Openings for Cleaning: Provide temporary openings at points in formwork to facilitate cleaning and inspection. At base of walls and wide piers, bottom form board on one face for entire length shall be omitted until form has been cleaned and inspected.

- C. Chamfers: Provide 3/4 inch by 3/4 inch chamfer strips for all exposed concrete corners and edges unless otherwise indicated.
- D. Reglets and Rebates: As specified in Section 03 30 00: Cast-In-Place Concrete.

3.4 REMOVAL OF FORMS

- A. Forms shall not be removed until concrete has sufficiently hydrated to maintain its integrity and not be damaged by form removal operations. Unless noted otherwise and/or permitted by the Architect, columns and wall forms shall not be removed in less than five days, floor slabs in less than seven days, beams and girders in less than 15 days, pan forms for joists may be removed after three days, but joist centering shall not be removed until after 15 days, and ramp, landing, steps and floor slabs shall not be removed in less than seven days. Shoring shall not be removed until member has acquired sufficient strength to support its weight, load upon it, and added load of construction.
- B. Compressive strength of in-place concrete shall be determined by testing field-cured specimens representative of concrete location or members, as specified in Section 03 30 00: Cast-In-Place Concrete.

3.5 PROTECTION

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

3.6 CLEAN UP

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

END OF SECTION

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SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete steel reinforcement.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 40 00: Quality Requirements
 - 3. Section 03 10 00: Concrete Forming.
 - 4. Section 03 30 00: Cast-In-Place Concrete.

1.2 REGULATORY REQUIREMENTS

- A. Fabrication and placement of reinforcing shall be in accordance with requirements of CBC-SS/CC, Chapter 19A.

1.3 REFERENCES:

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 - 3. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - 5. ASTM A497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - 6. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

7. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
- B. American Concrete Institute (ACI) Publication:
1. ACI SP-66 – ACI Detailing Manual.
 2. ACI 318 – Building Code Requirements for Structural Concrete, as modified by CBC Sections 1903A and 1908A.
- C. American Welding Society (AWS):
1. AWS D1.4 – Structural Welding Code – Reinforcing Steel.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
 2. American Welding Society (AWS).
 3. American Concrete Institute (ACI).
 4. CBC-SS/CC, Chapter 19A, Concrete.
- B. Source Quality Control: Refer to Division 01 Sections for general requirements and to the following paragraphs for specific procedures. Testing laboratory retained by the Owner shall select test Samples of bars, ties, and stirrups from the material at the Project Site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A615, or ASTM A706, as applicable:
1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.

- 2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained; perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.
- C. Certification of Welders: Shop and Project site welding shall be performed by welding operators certified by AWS.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 MATERIALS

- A. Steel Reinforcing Bars: ASTM A615, or ASTM A706 deformed grade 60 billet steel unless otherwise specified or indicated.
- B. Tie Wire: ASTM A82, fully annealed, copper-bearing steel wire, 16 gage minimum.
- C. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI 315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.3 FABRICATION OF REINFORCING BARS:

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.
- C. Welding: Provide only ASTM A706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and

specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC-SS/CC requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings.
- B. Before installation and just prior to placing concrete, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.
- C. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.
- D. Provide metal chairs to hold reinforcement the required distance above form bottoms. In beams and slab construction, provide chairs under top slab reinforcement as well as under bottom reinforcement. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.
- E. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustations while they are still soft.
- F. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.
- G. Use deformed bars unless otherwise indicated, except for spiral reinforcement.

3.2 CLEAN UP

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

3.3 PROTECTION

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

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place normal weight and lightweight concrete, placement and finishing.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 32 13 13: Site Concrete Work.
3. Section 03 10 00: Concrete Forming and Accessories.
4. Section 03 20 00: Concrete Reinforcing.

1.2 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
4. ACI 305R - Specification for Hot Weather Concreting.
4. ACI 306.1 – Standard Specification for Cold Weather Concreting.
5. ACI 318 - Building Code Requirements for Structural Concrete, as modified by CBC-SS/CC Sections 1903A and 1908A.

B. American Society for Testing and Materials (ASTM) Standards:

1. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.

3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C88 - Standard Test Method for Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
10. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
11. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
12. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
14. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
15. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
16. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
17. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
19. ASTM C845 - Standard Specification for Expansive Hydraulic Cement
20. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

21. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
22. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
23. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures
24. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
25. ASTM D1751 - Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
26. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
27. ASTM E1155 - Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.
28. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
29. ASTM E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.
- B. Mix Design Data: Submit concrete mix designs as specified herein and in Article 2.02.
 1. Submit name, address and telephone number of the concrete production facility which the contractor intends to engage to design the concrete mixes. Submit name and qualifications of the proposed concrete technologist.
 2. Mix Design: Submit a concrete mix design for each strength and type of concrete indicated in the drawings or specified. Include water/cement ratio, source, size and amount of coarse aggregate and admixtures. Predict minimum compressive strength, maximum slump and air content percentage. Clearly indicate locations where each mix design will be used.

3. Test Reports: Submit copies of test reports showing that the proposed mixes produce concrete with the strengths and properties specified. Include tests for cement, aggregates and admixtures. Provide gradation analysis.
- C. Material Samples: Submit Samples illustrating concrete finishes and hardeners, minimum 12-inch by 12-inch.
- D. Certificates: Submit certification that each of the following conforms to the standards indicated:
 1. Portland cement: ASTM C150.
 2. Normal weight concrete aggregates: ASTM C33.
 3. Lightweight concrete aggregates: ASTM C330.
 4. Aggregates: Submit evidence that the aggregate is not reactive in the presence of cement alkalis. In the absence of evidence, aggregate shall be tested per ASTM C289. If results of test are other than innocuous, aggregates shall be tested per ASTM C1567 as reported per ACI 318 as modified by CBC-SS/CC, Section 1903A.3.
 5. Curing materials: ASTM C171.
- E. Admixtures: Submit product data for proposed concrete admixtures.

1.4 QUALITY ASSURANCE

- A. Continuous inspection shall be provided at the batch plant and for transit-mixed concrete to run check sieve analysis of aggregate, check moisture content of fine aggregate, check design of mix, check cement being used with test reports, check loading of mixer trucks, and certify to quantities of materials placed in each mixer truck.
- B. Inspection shall be performed by a representative of a testing laboratory selected by the Owner. Owner will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.
- C. Contractor shall assist the testing laboratory in obtaining and handling samples at the project site and at the source of materials.
- D. Continuous batch plant inspection requirement may be waived in accordance with CBC-SS/CC Section 1704A.4.3. Waiver shall be in writing, including DSA approval. When batch plant inspection is waived by DSA, the following requirements shall be met:

1. Approved inspector of the testing laboratory shall check the first batching at the start of work and furnish mix proportions to the licensed weightmaster.
 2. Licensed weightmaster shall positively identify materials as to quantity and certify to each load by a ticket.
 3. Tickets shall be transmitted to the Inspector by a truck driver with load identified thereon. The Inspector will not accept the load without a load ticket identifying the mix and will keep a daily record of placements, identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to DSA.
 4. At the end of the project, the weightmaster shall furnish an affidavit to DSA certifying that all concrete furnished conforms in every particular to proportions established by mix designs.
- E. Special Inspections and Tests shall be in accordance with CBC-SS/CC Chapter 17A, Reinforcement and Anchor testing per CBC-SS/CC Section 1916A and Specification Section 01 4523.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.
- B. Packaged materials shall bear the manufacturers and brand name label, and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.

1.6 PROJECT CONDITIONS

- A. Cold Weather Requirements: Batching, mixing, delivering and placing of concrete in cold weather shall comply with the applicable requirements of ACI 306.1.
- B. Hot Weather Requirements: Batching, mixing, delivering and placing of concrete in hot weather shall comply with the applicable requirements of ACI 305R.
- C. Concrete temperature of freshly mixed concrete shall be determined per ASTM C1064.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: ASTM C150. Portland Cement.
- B. Aggregates: Conform to the following standards:

1. Normal weight concrete: ASTM C33.
 2. Lightweight concrete: ASTM C330, with fine aggregates per ASTM C33.
 3. Aggregate shall be tested for Potential Alkali Reactivity of Cement-Aggregate Combinations per ASTM C289.
 4. Nominal maximum size of coarse aggregate shall be no larger than:
 - a. 1/5 the narrowest dimension between sides of forms, nor
 - b. 1/3 the depth of slabs, nor
 - c. 3/4 the clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, or ducts.
 - d. Contractor may request the Architect and DSA waiver of the above limitations reported per ACI 318 as modified per CBC-SS/CC Section 1903A.3, provided that the workability and methods of consolidation are such that the concrete can be placed without honeycombs or voids.
- C. Water: Water for concrete mixes, curing and cleaning shall be potable and free from deleterious matter.
- D. Admixtures: Shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with ACI 318, Section 3.6.
1. Admixtures containing chlorides or sulfides are not permitted.
 2. Air-entraining admixtures shall comply with ASTM C260. Air-entrained admixtures shall not be used for floor slabs to receive steel trowel finish.
 3. Admixtures for water reduction and setting time modification shall conform to ASTM C494.
 4. Admixtures for producing flowing concrete shall conform to ASTM C1017.
 5. Fly ash, pozzolan and ground granulated blast-furnace slag: Modify ACI 318 Sections 3.6.6 and 3.6.7 as follows:
 - a. Fly ash or other pozzolan used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:
 - 1) Shall conform to ASTM C618 for Class N or F materials
 6. Admixtures containing ASTM C845 expansive cements shall be compatible with the cement and produce no deleterious effects.

7. Silica fumes used as an admixture shall conform to ASTM C1240.
- E. Reinforcement Fibers: Chop strands of alkali-resistant polypropylene or nylon fibers added to the concrete mix for protection against shrinkage cracks.
 - F. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D1751.
 - G. Curing Paper: Shall conform to ASTM C171 and consist of two sheets of kraft paper cemented together with a bituminous material in which are embedded cords or strands of fiber running in both directions. The paper shall be light in color, shall be free of visible defects, with uniform appearance.
 - H. Floor Hardener: Water soluble, inorganic, silicate-based curing, hardening, sealing and dustproofing compound. Aquaseal W20 by Monopole Inc., Kure-N-Harden by BASF, Chem Hard by L&M, Liqui-Hard by W. R. Meadows, or equal.
 - I. Underlayment: Two component latex underlayment for filling low spots in concrete for both interior and exterior applications, from featheredge to a maximum of 3/8 inch in thickness. Underlayment shall be non-shrink and suitable for repairing exposed concrete surfaces and for underlayment of carpet, resilient, tile and quarry floor coverings. La-O-Tex by TexRite, Underlay C, RS by Mer-Krete Systems, Underlayment 962 by C-Cure, or equal.
 - J. Vapor Barrier: Polyolefin-based 15 mils minimum thickness, meeting or exceeding ASTM E1745, 10 feet minimum width. Permeance shall be less than 0.01 perms [grains/(ft²*hr*inHg)] as determined by ASTM E96 or ASTM F1249 and after mandatory conditioning tests per ASTM E154 Sections 8, 11, 12, & 13. Include accessories including tape and/or mastic. Stego Wrap by Stego Industries LLC, Perminator by W.R. Meadows, Ecoshield-E by Epro, or equal.
 - K. Stair Strips and Nosing: Nystrom two part stair treads and nosings.

2.2 CONCRETE MIX

- A. Mix shall be signed and sealed by a Civil or Structural Engineer currently registered in the State of California.
- B. The required strength and durability of concrete shall be determined by compliance with the proportioning, testing, mixing and placing provisions of CBC-SS/CC Sections 1905A.1 through 1905A.13. Concrete mix shall meet the durability requirements of ACI 318, Chapter 4.
- C. Concrete proportioning shall be determined on the basis of field experience and/or trial mixtures shall in accordance with ACI 318, Section 5.3. Proportions of materials shall provide workability and consistency to permit concrete to be placed readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding.

D. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of ASTM C94.

E. Provide concrete to the following criteria:

	Min. 28-day	Max.	Max. Size
Element	Strength psi	Slump	Aggregate
Grade Beams and Foundation	4,000	4 inch	1" Normal wt. concrete
Slabs	4,000	4 inch	¾" Normal wt. concrete
Other	3,000	4 inch	¾" Normal wt. concrete

PART 3 - EXECUTION

3.01 GENERAL

- A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.
- B. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the Inspector at least 24 hours before placing concrete; do not place concrete until inspected by the IOR.
- C. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the Architect and DSA.

3.2 TOLERANCES

- A. Concrete construction tolerances shall be as specified in ACI 117 and as modified herein.
- B. Refer to ACI 302.1R, Tables 8.1 and 8.2 Slab on Ground and Suspended Flatness/Levelness Construction Guide, for recommended concrete placing and finishing methods.
- C. Floor Flatness and Floor Levelness shall be tested in accordance to ASTM E1155. Floor measurements shall be made within 48 hours after slab installation and shall precede removal of shores and forms.

3.3 PREPARATION

- A. Vapor Barrier: Before installation of screeds and slab reinforcement, install vapor barrier under slabs on grade, as indicated in the drawings.
1. Install in accordance to ASTM E1643.
 2. Place vapor retarder sheeting with the longest dimension parallel with the direction of the concrete pour.
 3. Laps or seams shall be overlapped 6 inches, or as recommended by manufacturer. Laps and penetrations shall be sealed with the manufacturer's recommended tape and/or mastic.
 4. Inspector will inspect and mark areas of damage and insufficient installation of the vapor barrier sufficiently in advance of concrete placement.
 - a) Deficiencies shall be corrected before concrete is placed.
 - b) Patch damaged areas with vapor barrier overlapping four sides 6 inches and adhering with tape.
- B. Reglets and Rebates:
1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
 2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.
- C. Anchor Slots: Embedded anchor slots in concrete walls to receive masonry veneer shall be set vertically in forms, 24 inches maximum on centers measured horizontally. Anchor slots shall be No. 24 gage galvanized sheet steel with removable fiber filler to prevent seepage of cement in slot.
- D. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

3.4 INSTALLATION

- A. Conveying and Placing:
1. Concrete shall be placed only under direct observation of the PI. Do not place concrete outside of regular working hours, unless the Inspector has been notified at least 48 hours in advance.

2. Concrete shall be conveyed from mixer to location of final placement by methods that will prevent separation or loss of materials.
3. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete which has been remixed after initial set be placed.
4. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.
5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
6. Concrete shall be thoroughly consolidated by suitable means during placement, and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.
7. Where conditions make consolidation difficult or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.

B. Cold Weather:

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. All ground with which concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.
2. The temperature of concrete at the time of placement shall not be below the minimum temperatures given in Table 3.1 of ACI 306.1.
3. Concrete shall be maintained at a temperature of at least 50° F. for not less than 72 hours after placing or until it has thoroughly hardened. Cover concrete and provide sufficient heat as required. When necessary, aggregates shall be heated before mixing. Special precautions shall be taken for protection of transit-mixed concrete.

C. Hot Weather:

1. Concrete to be placed during hot weather shall comply with the requirements of ACI 318, Section 5.13.
2. Maintain concrete temperatures indicated in Table 2.1.5 of ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square feet of exposed concrete per hour.
3. Cool concrete using methods indicated in ACI 305R Appendix B.
4. Place and cure concrete as specified in ACI 305R Chapter 4.

D. Compaction and Screeding:

1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.
2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.

E. Floating and Troweling:

1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.
2. For interior finish slabs, final troweling shall provide a hard, impervious, and non-slip surfaces, free from defects and blemishes. Finished surface shall be within tolerances indicated in Article 3.02. Avoid burnishing. Do not add cement or sand to absorb excess moisture.
3. Exterior Paving and Cement Walks: Finish as specified above, except surface shall be given a non-slip broom finish to match Sample reviewed by the Architect.
4. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.

F. Curing:

1. Length of time, temperature and moisture conditions for curing concrete shall be in accordance with ACI 318, Section 5.11.
2. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.
3. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.
4. Immediately after finishing, monolithic floor slabs shall be covered with curing paper. Paper shall be lapped 4 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.

G. Filling, Leveling and Patching:

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

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

3.5 FINISHING

- A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.
- B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking

operation for any continuous area shall be started and completed within the same day.

1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.
 2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.
- C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sandblasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.
- D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish.
- E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener.
1. Protect adjacent surfaces. Clean surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, laitance, dust and dirt are removed prior to application.
 2. Apply hardener in accordance with manufacturer's instructions as soon as concrete is firm enough to work on after final troweling.
- F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.
- G. Broom Finish: Exterior stair treads and landings shall be provided with a non-slip broom finish in addition to abrasive finish specified.
- H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturers written recommendations.

3.6 EXPANSION AND CONSTRUCTION JOINTS

- A. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:
1. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
 2. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.
 3. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.
- B. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab. Joint filler shall be 3/8 inch thick, unless otherwise indicated.
- C. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

3.7 TESTING

- A. Molded Cylinder Tests:
1. Inspector or testing lab personnel will prepare cylinders and perform slump tests. Samples for concrete strength shall be taken in accordance to ASTM C172. Each cylinder shall be dated, given a number, point in structure from which sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.
 2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of three days, seven days, and 28 days. A strength test shall be the average of the compressive strength of two cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'_c .
 3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C31, and tested in accordance with ASTM C39.

- B. Core Test: At request of the Architect, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC-SS/CC and ASTM C42.
1. Provide 4 inch diameter cores at representative places throughout the structure as designated by the Architect.
 2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.
 3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.
- C. Concrete Consistency: Measure consistency according to ASTM C143. Test twice each day or partial day's run of the mixer.
- D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, falls below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.
- E. Air Content Testing: Measure in accordance to ASTM C173 or ASTM C231, for each composite sample taken in accordance to ASTM C172.
- F. Defective Concrete:
1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the Architect and DSA.
 2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to intended grades and levels, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.
- G. Concrete for Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall have a minimum $f_c = 3,000$ psi. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 03 1000 Concrete Forming and Accessories, and reinforced as described in Section 03 2000 Concrete Reinforcing. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4 inch maximum aggregate.

3.8 CLEAN UP

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

3.9 PROTECTION

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

END OF SECTION

SECTION 03 35 43

RESTOSHINE ARCHITECTURAL POLISHED CONCRETE SYSTEM

PART 1 – GENERAL

1.1 SUMMARY:

- A. This is the specification for RESTOSHINE Architectural Polished Concrete System by RESTOCRETE. 'Or equal' products from other manufacturers will be considered. Equal must be approved per Substitutions 01 25 00.
- B. New Concrete 800 Grit – Class B (Salt&Pepper) / Level 3 (Med/High Gloss)
- C. Complete installation details are provided in the RESTOSHINE Architectural Polished Concrete Specification included below.
- D. RESTOSHINE polished concrete finish is a combination of mechanical grinding, honing and polishing combined with chemical treatments to produce a fully refined surface that is dust proof, durable, stain resistant, light reflective and easy to maintain.

1.2 SECTION INCLUDES:

- A. Products and procedures for the installation of the RESTOSHINE Architectural Polished Concrete System using a multi-step mechanical process and accessories indicated, specified or required to complete system and achieve specified finish:
 - 1. Mechanical Diamond Grinding utilizing approved Polishing Equipment.
 - a. Large Platform Planetary grinder with 750lbs head pressure minimum
 - 2. RESTOSHINE Concrete Treatment Chemicals
 - 3. RESTOFILL Joint filler and RESTOGROUT repair materials.
 - 4. Products and procedures for the initial and long-term maintenance of the RESTOSHINE Architectural Polished Concrete System.

1.3 SUBMITTALS:

- A. Product Data: Submit Manufacturer's technical literature for each product indicated, specified, or required. Include manufacturer's technical data, application instructions, recommendations and MSDS.
- B. Installer Qualifications: Data for company, principal personnel, experience,

and training. Provide a letter documenting installer's accreditation and certification compliance, as specified under quality assurance.

- C. Maintenance Data: Provide manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under intended use. These instructions should contain precautions against cleaning products and methods, which may be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE / WARRANTY:

- A. Warranty Requirements: The RESTOSHINE Architectural Polished Concrete System consists of a process and products engineered and manufactured by RESTOCRETE. No substitutions are permitted and void warranty, unless approved prior to commencement. The complete list of warranty requirements may be obtained through RestoCrete, Inc. at (714)763-0505.
- B. Installer Qualifications:
 - 1. Installer must be approved and certified for the RESTOSHINE Architectural Polished Concrete System.
 - 2. Installer must be experienced in performing specified work similar in design, products and scope of this project, with a documented track record of successful, in-service performance and with sufficient production capabilities, facilities and personnel to produce specified work.
 - 3. A RESTOSHINE certified supervisor must be maintained on site at all times, during which the specified work is performed. For a complete list of qualified installers in your region contact Kevin Partin, the RestoShine National Sales Manager, at (619) 565-5220
 - 4. National brand specific projects must have RestoCrete, Inc. personnel, or an approved certified supervisor, present during the pre-construction conference to ensure quality control standards are in compliance.
 - 5. Installer must provide written documentation from the manufacturer confirming the Installer's current accreditation and training from RESTOCRETE on installation of the RESTOSHINE Architectural Polished Concrete System and related equipment and processes. Failure to provide current accreditation will void any warranty implied or otherwise associated with the RESTOSHINE Architectural Polished Concrete System.
 - 6. A current list of qualified installers may be obtained through RestoCrete, Inc., by contacting the RestoShine National Sales Manager, Kevin Partin at (619) 565-5220.

- C. Mock-Up: Before performing the work in this section, an adequate on-site mock-up of the RESTOSHINE Architectural Polished Concrete System representative of specified process, surface, finish, color and joint design/treatments must be installed for review and approval. These mock-ups should be installed using the same size machine and personnel who will perform work. The minimum size shall be 10' x 10' to show the complete process. Approved mock-ups may become part of completed work, if undisturbed at time of substantial completion.
- D. Static Coefficient of Friction: A reading of not less than 0.5 for level floor surfaces shall be achieved and documented as determined by certified an NFSI walkway auditor using the ASTM D-2047 quality control test.
- E. Dynamic Coefficient of Friction: Per 11B-302.1, General. Floor and ground surfaces shall be stable, firm, and slip resistant and shall comply with Section 11B-302.
1. Exterior surfaces: Per ANSI A137.1, a reading of not less than 0.6 for level floor surfaces shall be achieved and documented as determined by certified an NFSI walkway auditor using the ANSI B101.3 quality control test.
 2. Interior surfaces: Per ANSI A137.1, a reading of not less than 0.42 for level floor surfaces shall be achieved and documented as determined by certified an NFSI walkway auditor using the ANSI B101.3 quality control test. This specification is based on wet DCOF measurement performed according to ANSI A326.3.
- F. Floor moisture testing: A reading not greater than 80% RH shall be accepted as measured by ASTM F-2170 Standards. An acceptable MVER shall be 6 pounds or less as measured by ASTM F-1896-04. See reference 1.06-H.
- G. Test Reports: Comply with the provisions of the following specifications and standards, except as otherwise noted or specified, or as accepted or directed by the Owner and/or Architect. All test data shall be recorded and submitted upon completion of the job.
1. Section 03 30 00, Cast-In-Place Concrete
 2. ASTM D-523, Standard Test Method for Measurement of Gloss of High-Gloss Surfaces by Abridged Goniophotometry.
 3. ASTM D-4039-09 Standard Test Method for Reflection Haze of high Gloss Surfaces.
 4. ASTM D-2047-11 Standard Specification for Coefficient of Friction.

5. ASTM F-2170-17 Standard Test Method for Relative Humidity in Concrete Floors.
 6. ASTM F1869-16a—Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub floors using Anhydrous Calcium Chloride
 7. ANSI B-101.3 Dynamic Coefficient of Friction.
 8. ACI 310 R-13 Guide to Decorative Concrete, section 7.2
 9. CPC (Concrete Polishing Council) Polished Concrete Aggregate Exposure Chart.
 10. CPC (Concrete Polishing Council) Polished Concrete Appearance Chart.
- H. Pre-Installation Conference: Prior to the installation of the RESTOSHINE Architectural Polished Concrete System, an on-site conference shall be conducted to review specification requirements.
1. Required attendees include the Owner, Architect, General Contractor, RESTOSHINE Architectural Polished Concrete System Subcontractor, and RestoCrete, Inc. representative as required in 1.04-B section d, Quality Assurance.
 2. The minimum agenda shall include:
 - a. Review slab finish requirements, F-numbers and finishing practices.
 - b. Review of System requirements, including drawings, specifications and other contract documents.
 - c. Review of mock-up location, size and equipment. See reference in section 1.04-C.
 - d. Review and finalization of installation schedule, and verification of availability of required materials, trained Installer personnel, equipment and facilities to execute specification and avoid delays.
 - e. Limit access to work area by other trades to reduce possible damage to the floor before, during and after completion. To include no pipe cutting on floor. All lifts must be diapered to prevent drips or staining.
 - f. Review of required inspection, testing, certification and material usage accounting procedures.
 - g. Review of power requirements and responsibility

- h. Review of temporary protection requirements during and after installation.
- i. Review of cleaning procedures during and after installation. Reference section 3.08 or RESTOSHINE Maintenance Specification 030900.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver all materials in original containers, bearing manufacturer's labels indicating brand name and directions for storage, factory numbered and sealed until ready for installation.
- B. Maintain copies of all chemical MSDS, and technical data sheets for all products.
- C. Store all materials in a dry, climate-controlled environment at a minimum of 55°F (13°C) and maximum of 85°F (29°C).

1.6 SITE CONDITIONS

- A. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting the floor finish.
- B. Close areas to traffic during and after RESTOSHINE Architectural Polished Concrete System application for a time period recommended by RESTOCRETE®
- C. Inspect the existing substrate and document unsatisfactory conditions in writing. Verify that surfaces and site conditions are ready to receive work. Correct unacceptable conditions prior to installation of System. Commencement of work constitutes acceptance of substrate conditions.
- D. Existing concrete must be cured for a sufficient time period as recommended by RESTOCRETE before the application can begin, typically 21-28 days.
- E. Protect existing concrete and the new RESTOSHINE Architectural Polished Concrete System from contamination by petroleum, oil, hydraulic fluid, acid and acidic detergents, paint and other liquid dripping from trades and equipment working over these substrates. If construction equipment must be used on these substrates, diaper all components that may drip fluids.
- F. Prohibit the placement and storage of construction materials over new RESTOSHINE Architectural Polished Concrete System, to include ferrous metals and steel members.

- G. Prohibit vehicle parking and pipe cutting operations over concrete before and after the RESTOSHINE Architectural Polished Concrete System.
- H. Moisture Vapor Testing
 - 1. Test existing concrete for moisture vapor transmission according to methods indicated in ASTM F1869-04. Acceptable results: not more than 6 pounds per 1,000 square feet in 24 hours.
 - 2. Test existing concrete for relative humidity using in situ probes according to ASTM F2170. Acceptable results: not more than 80%.
 - 3. An exception for high moisture floors may be obtained in writing from RESTOCRETE, upon request. Contact the main office @ (714) 763-0505.
 - 4. The owner or concrete contractor shall be responsible for any and all testing conducted.

PART 2 – PRODUCTS

2.1 SYSTEM INTEGRITY:

- A. The RESTOSHINE Architectural Polished Concrete System is an engineered and integrated complete installation system requiring strict adherence to all specified installation processes, equipment, diamond abrasives, concrete preparation, joint treatment, and chemicals to achieve the intended result. Any unapproved substitutions from the specified products and/or processes will void the system warranty.

2.2 MATERIALS:

- A. RESTOSHINE approved list of Equipment
 - 1. Diamatic® BMG-780 Planetary Grinder and Polisher, or similar, large platform: 32” planetary floor polisher. Minimum head pressure of 725 lbs.
 - 2. 27” High Speed Propane Burnisher or 27” High Speed Electric Burnisher
 - 3. Vacuums: Dust Collection must be designed for filtering concrete dust and have HEPA filtration, as required by OSHA Standards. Minimum air speed of 340 CFM for Large and Medium Platform equipment.
- B. RESTOCRETE Diamond Abrasives and Blades (or approved equal):
 - 1. Metal Bonded Diamonds – 18/20, 30/40, 60/80, 120-140 Grits.

- a. Note: Concrete has hardness levels of soft, medium and hard. The hardness of the concrete will determine the required hardness of the metal bonded diamonds:
- b. Semi-Metal Bonded Diamonds, 50, 100, 200 Grit. Wet use only.
- c. Transitional Diamonds, - #0, #1, #2 Grit.
- d. Resin Bonded Diamonds -50, 100, 200, 400, 800, 1500, 3000 Grit.
- e. 7" Diamond Impregnated Burnishing Pads – 200, 400, 800, 1500, 3000 Grit.
- f. Ceramic wheels for hand grinders – 30-50-100-270-400 Grit. Available in 5" and 7".

C. RESTOSHINE CONCRETE TREATMENT CHEMICALS (714) 763-0505

- 1. RestoHard Lithium Densifier for standard concrete and terrazzo or approved equal.
- 2. RestoGuard Stain and Wear Protection Treatment (high-gloss) or approved equal.

D. RESTOSHINE REPAIR MATERIALS

- 1. RESTOGROUT Epoxy Grout Coat Repair Material or approved equal.
- 2. RapidSet Skim Coat Cementitious Repair Material or approved equal.

E. JOINT MATERIALS

- 1. RestoFill 100% solids polyurea joint filler
- 2. METZGER MCGUIRE 100% solids polyurea joint filler
 - a. SPAL-PRO RS 88 Rapid Set Polyurea Joint Filler

F. PROTECTION MATERIALS

- 1. To prevent minor damage from light trade traffic during build out of site, an approved Construction grade flooring protection material for the RESTOSHINE Architectural Polished Concrete System may be installed. At no time will any tape be used or applied to a finished RESTOSHINE surface as the adhesive may leave a permanent residue or remove the surface finish.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Inspect all concrete substrates and conditions under which the RESTOSHINE Architectural Polished Concrete System is to be installed.
- B. Verify that all surfaces and site conditions are ready to receive work; document and correct conditions detrimental to timely and proper installation of work. Beginning work constitutes acceptance of substrate condition.
- C. Verify that existing concrete has cured a minimum of 28 days and meets finish and surface profile requirements in Division 03 Section "Cast-In-Place Concrete," before installing the RESTOSHINE Architectural Polished Concrete System.
- D. Inspect mock-up panel to insure it is satisfactory and meets all of the owner's requirements. The mock-up panel shall be a minimum size of 10'x10'.

3.2 PREPARATION

A. DEMOLITION

- 1. Clear surfaces of any debris and construction materials.
- 2. Power connections for the equipment of the RESTOSHINE Architectural Polished Concrete System shall be located and prepared by the general contractor.
- 3. Using the appropriate mechanical means and methods, remove existing floor coverings and coatings, including but not limited to carpet VCT, ceramic tile and grout, wood, epoxy/ urethane, quartz, mastic, adhesives, paint or other non-concrete floor materials. Adhesives must be removed to their penetrated depth.
 - a. Note: The mechanical removal of resilient flooring, backing, lining felt, cutback and other adhesives can be hazardous, as certain materials may contain asbestos or crystalline silica. Do not sand, dry sweep, dry scrape, drill, saw, bead blast, grind, mechanically chip or pulverize these materials, as harmful dust may result. Inhalation of this dust may cause asbestosis or other bodily harm. Please consult the adhesive manufacturer, the Resilient Floor Covering Institute (www.rfci.com) and all applicable government agencies for rules and regulations concerning the handling and removal asbestos-containing materials.
 - b. Prevent any damage to concrete slab surface during demolition from chipping hammers. Existing flooring should be removed mechanically with walk-behind or ride-on scraping equipment.
- 4. Chemical preparation of the substrate is NOT acceptable, including but

not limited to acid etching, sweeping compounds, solvents and adhesive removers.

5. Suppress dust during demolition with the use of dust collection equipment to reduce or eliminate airborne concrete and substrate dust.
6. Where existing concrete is cracked, damaged, spalled, not within specified tolerance, or contains unacceptable levels of contaminants or moisture vapor, the Installer of the RESTOSHINE RESTOCRETE Polished Concrete System will evaluate conditions and proceed with appropriate RESTOSHINE System components.
7. For specific repairs apply the RestoGrout, or RapidSet Skimcoat, in accordance with the Technical Data Sheet.

B. Joint Fill(Indoor)

1. All joint fill materials shall be installed in accordance with the written instructions provided in the approved manufacturer's technical data.
2. For the best results all joints should be filled before or after the first pass of metal bonded diamonds, but before any further grinding continues.
3. If the joint filling will occur after the polishing process, apply soap or another product as instructed by the manufacturer to the edge of the concrete to prevent staining the concrete surface.

3.3 FLOOR MEASUREMENTS:

- A. Gloss readings are not to be obtained through the use of any microfilming products, sealers, coatings, enhancers or as the result of resin transfer from resin bond abrasives.

1. Level 2 Sheen – Low Gloss reading of 30 to 40. 400 grit diamond finish.
2. Level 3 Sheen – Medium Gloss reading of 41 to 69. 800 grit diamond finish.
3. Level 4 Sheen – High Gloss reading of 70 or higher. 1500 grit or above.

- B. For instructions on achieving gloss levels, refer to the appropriate sub-section of section 3.04.

Use the section below to determine specific finish details for the project.
Refer to section 3.04-C for specific tooling and process steps.

C. CUT LEVELS / CLASS

1. CLASS A CUT / A light cut that removes the surface paste exposing the fine aggregates near the surface. Also referred to as a light aggregate finish. Note that a Class1 cut will require higher F-numbers to achieve, Min FF 50.
2. CLASS B CUT / A slightly deeper cut that exposes the fine aggregates and begins to expose the coarse aggregates. Also referred to as a salt and pepper finish.
3. CLASS C CUT / A deep cut that exposes the coarse aggregates in the surface.

D. POLISHED CONCRETE PROJECT SPECIFIC DETAILS:

1. Specified floor finish shall have a Class Level of "B" - Salt & Pepper Finish
2. Specified floor finish shall have a Appearance Level of “3” - Med Gloss (41 to 69)

Reference for stated levels: CPC Aggregate Exposure Chart / Appearance Chart for polished concrete.

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3.4 POLISHING:

- A. GRIND/POLISH #1: 60/80 Grit Metal Bonded Diamonds to expose desired salt & pepper exposure. (Cross hatch, double pass)
- B. Squeegee, vacuum or auto-scrub to remove all residual dust.
- C. GRIND/POLISH #2: 100 Grit Transitional Diamonds, Ceramic Bonded. Cross hatch, double pass to remove metal bonded scratches.
- D. GRIND/POLISH #3: 200 Grit Resin Bonded Diamonds.
- E. Squeegee, vacuum or auto-scrub to remove all residual dust.
- F. Apply RESTOCRETE RestoHard™ per application instructions at a rate of 400 square feet per gallon.
- G. Allow RESTOCRETE RestoHard™ to dry 1 hour before continuing to the next step.
- H. GRIND/POLISH #6: 400 Grit Resin Bonded Diamonds.
- I. Squeegee, vacuum or auto-scrub to remove all residual dust.
- J. GRIND/POLISH #7: 800 Grit Resin Bonded Diamonds.
- K. Squeegee, vacuum or auto-scrub to remove all residual dust.
- L. MICROPOLISH/BURNISH #1: Using 800 Diamond Impregnated Pad.
- M. Dry mop the floor clean to remove all debris..
- N. Apply RESTOCRETE RestoGuard™ (High Gloss) per application instructions at a rate of 2500- 3,000 square feet per gallon.
- O. Allow to dry a minimum of 15 minutes.
- P. MICROPOLISH/BURNISH #2: Using 800 Diamond Impregnated Pad.
- Q. Apply a second coat of RestoGuard™ (High Gloss) Allow to dry for 15 minutes.
- R. MICROPOLISH/BURNISH #3: 800 Diamond Impregnated Pad

3.5 EDGES:

- A. Where required polished edge work of all areas shall be done with a 5” or 7” Hand Held or Walk Behind polishing tool, or equal. The edge polishing process will match the corresponding steps outlined above for the desired gloss level, and each edge polishing step shall be done immediately after the matching main polishing step.

- B. NOTE: All grinding and polishing completed with grinder/polisher equipment connected to a dust collector.

3.6 ACCEPTANCE:

- A. Remove all installation materials and any foreign materials resulting from the installation, from the site.
- B. Clean adjacent surfaces and materials.
- C. Perform post job walk to ensure that the RESTOSHINE Architectural Concrete System has been completed per the process spec.
- D. Take pictures of the final product for documentation and submittal, if requested or required.

3.7 PROTECTION

- A. Prevent any spills or stains from coming into contact with the floor. Clean any spills that may occur as quickly as possible.
- B. Protect the finished RESTOSHINE Architectural Polished Concrete System from continuing construction and build out as needed by installing the protective floor covering system.
 - 1. The installation of the protective floor covering must be approved by the Installer and General Contractor of the RESTOSHINE installation.
 - 2. If the protective floor covering material is damaged during use, then that section must be cut out and replaced to maintain the integrity of the protective covering.
 - 3. The protective floor covering shall be the responsibility of the general contractor.

3.8 ONGOING MAINTENANCE

- A. Restrict the use of water on the surface for 72 hours after initial installation. The surface should not be cleaned using a string mop for 60 days to avoid streaking of the RestoGuard. Avoid using mats or treated coverings for a minimum of 14 days to allow the finish to fully cure.
- B. DO NOT USE cleaners that are acidic or have citrus (de-limonene) or butyl compounds. Although the RESTOSHINE Architectural Polished Concrete System is chemical and stain resistant, the application of these high acid cleaners may etch the surface and cause a residual stain. Regular maintenance and cleaning will help prolong surface shine.

3.9 Daily Maintenance

- A. Once the system is fully cured out (min. 72 hours), routinely sweep, dry mop, use of a high quality micro-fiber dust mop is the best method. a neutral pH Daily Cleaner may be used when soils or stains must be removed. Any standing water should be removed immediately after cleaning.
- B. An auto-scrubber may be used if equipped with a vacuum system to remove any standing water. The equipment tank shall use a neutral pH daily cleaner, diluted in clean water. The scrubber shall be equipped with a soft pad only, DO NOT USE A BRUSH attachment.

3.10 Weekly Maintenance

- A. An auto-scrubber may be used if equipped with a vacuum system to remove any standing water, the equipment tank shall use a neutral pH cleaner, diluted in clean water. The scrubber shall be equipped with a soft pad only, DO NOT USE A BRUSH attachment.
- B. Use of a BURNISHER, equipped with a diamond impregnated pad, may be used as needed to restore gloss to specified levels. An 800,1500, or 3000 grit pad is recommended.

3.11 Extended Maintenance (between 3 to 5 years after installation)

- A. After thorough cleaning with a neutral pH cleaner and follow up using the auto-scrubber a maintenance coat of RestoGuard may be applied, as needed, to restore original gloss and increase the stain resistance on the surface. Follow all technical data instructions for proper application or consult the original floor installer for assistance.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing and installing of concrete unit masonry work as shown and noted on the drawings and as specified. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 CODES:

- A. Except as modified by the requirements specified herein and/or the details on the drawings, all concrete unit masonry work shall conform to the California Building Code "CBC", California Code of Regulations, Title 24, Part 2, Chapter 21A.

1.3 REFERENCES:

- A. The editions of the specifications and standards referenced herein, published by the following organizations, apply to the work only to the extent specified by the reference:
- B. American Concrete Institute (ACI).
- C. A Society for Testing and Materials (ASTM).
- D. Division of the State Architect, Structural Safety Section, IR 21-2.13 Interpretation of Regulations.

1.4 SUBMITTALS:

- A. Submittal procedures and quantities are specified in Section 01 33 00.
- B. Submit representative samples of masonry units to be used on the job for approval.

1.5 HANDLING AND STORAGE:

- A. Immediately upon delivery to the site, masonry units shall be stacked undercover or otherwise protected from exposure to the weather and from contact with soil. Care shall be exercised in handling these items to avoid chipping and breakage and to protect them from damage. Use of damaged blocks will not be permitted. Units shall be stored on pallets or temporary wood floors off the ground and out of the way of other trades.

1.6 PROJECT CONDITIONS:

- A. Do not lay masonry when ambient temperature is below 40 degrees F or when it is likely that the ambient temperature will fall below 40 degrees F during, or within 24 hours after, masonry laying operations.

1.7 COORDINATION:

- A. Locate dowel positions before concrete is placed so dowels match reinforcing steel in masonry. Furnish a dowel placing plan in addition to bar lists. Locate elevations for joint between concrete footing and masonry.
- B. Place bolts, anchors, drilled-in wedge anchors, metal attachments, nailing blocks and inserts required by other trades for attaching their work to masonry.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. The quality and design of all masonry used shall comply with the requirements of California Code of Regulations, Title 24, Chapter 21A.
- B. Concrete Masonry Units: Hollow load-bearing units, conforming to ASTM C90-06b, f'm = 2000 psi, medium weight units, except that units shall have a maximum linear shrinkage of 0.06%. Proper specially shaped units shall be used to provide for bond beams and lintels with a minimum of unit cutting. Block shall be Medium Weight, units 8" x 16" nominal face size, thicknesses as indicated. Units shall be Precision block. Colors to be selected from manufacturers standard colors.
- C. Cement: Standard Type I or II portland cement, conforming to ASTM C 150, low alkali.
- D. Lime: Hydrated, conforming to ASTM C 207, Type S.
- E. Mortar Sand: Natural sand, clean and graded, conforming to ASTM C 144, except not less than 3% shall pass No. 100 sieve.
- F. Aggregate for Masonry Grout: Pea gravel conforming to ASTM Designation C 404, except graded with not more than 5% passing a No. 8 sieve and 100% passing a 3/8" sieve.
- G. Sand for Grout: Washed, natural sand conforming to ASTM C 33 and having hard, strong and durable particles evenly graded with 5% minimum passing #100 screen and which does not contain more than 2% by weight of such deleterious substances as clay lumps, shale, shist, alkali, mica, coated grains or soft flaky particles.
- H. Admixtures:
 - 1. Grout: Sika "Grout Aid" type II or approved equal.

2. Mortar: Omicron Mortarproofing manufactured by Master Builders or approved equal.
 3. Pointing Mortar Sand: No. 1 ground white 80 mesh sand.
 4. Mortar Colors: Inorganic synthetic and natural iron oxides finely milled so that a minimum of 95% will pass a No. 325 sieve. Pigments shall be lightfast, alkali resistant, weather resistant, water soluble, and free of deleterious fillers and extenders. Coloring agent shall be packaged in measured units that can be added to measured amount of cement to achieve a uniform color between batches. Acceptable manufacturers include:
 - a. L.M. Scofield
 - b. Rockwood
 - c. Davis Colors
 - d. Solomon Colors
- I. Water: Clean and free of deleterious amounts of acids, alkalis, or organic materials.
- J. Mortar: Type S conforming to ASTM C 270 excluding masonry cement mixes.
- K. Grout: Coarse grout shall conform to ASTM C 476 and shall be used in grout spaces 2" wide or more in all filled cells.
- L. Lime Putty: Make from quicklime or hydrated lime. If from quicklime, other than pulverized (processed), quicklime, slake properly and screen through sieve of 16 meshes per linear inch. Before using, properly store and protect for not less than 10 days. If pulverized (processed quicklime) slake for at least 48 hours or until putty has cooled entirely. Putty must weigh at least 83lbs. per cu. ft.
- M. Packed Preblended Mortar Mixes: May be substituted upon approval of the Division of the State Architects office. DSA approval shall accompany mix submittal.
1. Preblended mix shall be approved by the Division of the State Architect.
- N. Anchors, Ties and Centering Devices: Factory fabricated from steel wire conforming to ASTM A82/A82M-07. Wire devices in all walls shall be formed from wire that has been zinc coated in accordance with ASTM A 116, Class 1.
1. Centering clips shall be formed from not lighter than 9 gage wire. Clips shall be of a design that will prevent displacement of reinforcing bars during the course of construction.
 2. Wire anchors for use with embedded slots or wire inserts shall be formed from not lighter than 9 gage wire looped and closed.
- O. Water: Fresh, clean and potable, and free from such amounts of mineral and organic substances as would adversely affect the hardening of cement mortar.

- P. Reinforcing Steel: Furnish and install reinforcing steel for grouted concrete unit masonry in accordance with the requirements of Section 03 30 00.
- Q. Weather seal system: High performance, clear, solvent-based elastomeric formula to weatherproof and protect concrete block and other porous masonry materials. PROSOCO, Inc. *"Sure Klean weather seal Blok-Guard & Graffiti Control 15"* or approved equal.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

- A. Begin work at least conspicuous corner of wall and request early inspection by Owner's Inspector. Make corrections in work as he may direct. All masonry shall be reinforced and shall be fully grouted.
- B. Coordinate with electrical work to align outlet boxes with masonry courses and joints to reduce cutting of units to minimum. Fit units neatly around and against pipes.
- C. Protect sills, ledges, offsets, jambs, corners from droppings of mortar and grout and from damage during construction.
- D. Neatly remove damaged masonry and replace with new work to match adjoining masonry.
- E. Walls: Lay plumb, level and to plane surface. Mortar joints straight, clean and uniform in thickness.

3.2 MIXING MORTAR AND GROUT:

- A. Mixing of Mortar: Mix mortar in accordance with TMS402/602-16. Admixtures shall be added in proportion and sequence as recommended by manufacturer. Do not use admixtures containing more than 0.2 percent chloride ions.
 - 1. Conventional Mortar: Lime shall be the last material added to the mix. Mix at least 3-minutes after all materials are in mixer. Equipment for mixing and handling mortar shall be of type approved by Architect and Division of the State Architect. Use mixer of at least one sack capacity. Hand mixing not allowed. Materials for mortar and grout shall be measured in suitable calibrated devices.
 - 2. Colored Mortar: Place 3/4 of the required water and 1/3 of the required sand into the rotating mixer. Then add all cement, lime, admixture, and coloring agent. Admixture and coloring shall be added at rates recommended by the manufacturer except that coloring agent shall not exceed 10% of the total weight of cementitious materials. Gradually add the remaining sand and water mixing for 5 minutes or

more as necessary to achieve a uniform color. Use a Mixer of at least one sack capacity. Materials for mortar shall be measured in suitable calibrated devices.

3. Maintain mortar on boards to slump of 2-3/4" plus or minus 1/4" using truncated cone 4" to 2" diameter, 6" high. Retemper mortar only on boards by adding water within basin formed with mortar and carefully work mortar and water together. Dashing or pouring water over mortar, not permitted. Discard mortar that has become harsh and non-plastic. When mortar has been maintained plastic, it may be use up to but not more than 60 minutes after original mixing.
 4. Mortar Design: Mortar used in unit masonry construction shall be composed of one part Portland cement and 3-1/2 max. parts of sand based on dry loose volumes and 1/4 part lime putty or dry hydrated lime. Mortar shall contain an approved admixture to reduce shrinkage and prevent efflorescence. Total mixing times shall be 3 to 5 minutes per ASTM C270-19. Mortar shall attain a minimum compressive strength of 1800 psi at 28 days.
- B. Mixing Grout: Mixing of grout shall conform to TMS 602/ACI 530.1/ACE 6 and meet the requirements of ASTM C476. Use transit mixed grout with sufficient water added so slump is near maximum (approximately 11" but not less than 8") without separation of aggregate and cement paste. Discard grout if not in final position by 2-1/2 hours after water is first added providing it is constantly rotated and grout remains in fluid condition. Move from mixer to place of final deposit as rapidly as practical by methods which prevent separation or loss of ingredients. Admixtures shall be added in the proportion and sequence as recommended by manufacturer.
1. Measure materials with accurately calibrated devices. Shovel measurements not allowed. Proportions of ingredients and any additives shall be based on laboratory or field experience with the grout ingredients and the masonry units to be used. Coarse grout proportioned by weight shall contain not less than 564 pounds of cementitious per cubic yard.
 2. Grout: Grout shall attain a minimum compressive strength of 2000 psi at 28 days; 1 part cement, 3 parts maximum of sand, 2 parts pea gravel. Add enough water to produce pouring consistency without segregation of aggregates. Add Sika "Grout Aid", Type II in strict accordance with manufacturer's recommendation for high lift grout. Masonry grout shall not contain integral water repellants.
 3. Pointing Mortar: 1 part white cement, 1/8 part lime putty, 1 part Ground White 80 mesh sand.

3.3 INSTALLATION:

- A. Laying Masonry Units: Do not install block or grout unless masonry inspector is present. Construction tolerances shall meet the requirements of TMS 602.
1. Do not use oil or grease marked units.

2. Remove dust or dirt from block surfaces before laying. Sandblast top of foundation to remove laitance from pores and expose the aggregate. Clean surface of all dust, dirt, organic matter, or debris. The contact surface of all foundations and floors that are to receive masonry work shall be prepared in accordance with TMS 602 before start of block placement. Protect the prepared surface during construction to assure a good bond between the grout fill and concrete surface.
 3. Prior to receiving grout, cells shall be clean of all deleterious materials and obstructions. Remove overhanging mortar from inside cells.
 4. Lay block in running bond.
 5. Minimum dimension of the grout spaces containing reinforcing steel shall be not less than 3-1/2".
 6. All head joints shall be full shoved.
 7. All bond beam units shall be deep cut units.
 8. Exterior exposed joints to be tooled with a concave joint to form a waterproof joint and a tight bond. Any mortar joints that are cracked or not bonded with the face shell of the masonry units shall be removed and joints repointed prior to grout placement.
 9. Bolts: All bolts which are embedded in masonry shall be grouted in place with not less than 1" of grout or drypack between the bolt and the masonry. Vertical bolts shall be placed inside horizontal ties located within 2" of the top at ends of walls. All bolt ties shall be hairpins, hooks or stirrups. Ties shall be not less than #3 bars. All bolts shall be accurately set with templates.
 10. Make block cuts with carborundum wheel or masonry saw.
 11. Piping other than electric conduit not allowed in block work unless shown on drawings.
 12. Chases not allowed unless shown on drawings.
 13. Install necessary forming and shoring true, rigid and strong enough to carry all dead and live loads without deflection. Keep lintel shoring in place at least 14 days after installing grout. All reinforcing shall be fully embedded in grout. The thickness of the grout between masonry units and reinforcing shall be a minimum of 1/2".
 14. Horizontal reinforcement shall be placed only in bond beam units.
- B. Grouting: Shall meet the requirements of "CBC", California Code of Regulations, Title 24, Part 2. Either high lift or low lift systems may be used.

- C. Low Lift Grout System: Shall be constructed in accordance with "CBC", California Code of Regulations, Title 24, Part 2.
1. This system includes placing reinforcing steel before or during construction of wall, pouring grout in lifts not to exceed 4'-0" all as specified herein.
 2. Lay no block unless under continuous inspection of masonry inspector. Keep mortar out of grout spaces.
 3. Place reinforcing steel accurately according to drawings and notes thereon. Hold vertical steel firmly in position. Use frames or other suitable devices to prevent movement or jarring while placing masonry. Place horizontal steel as work progresses. Lap steel at least 40 bar diameters. Extend steel through points of stoppage to provide required lap. Horizontal steel may be wired temporarily above required position and tagged to indicate its location and vertically marked indicators maintained showing required location of horizontal bars. If doubt exists whether or not steel has been properly placed, use drill to locate same, or open masonry as required by Architect. Make repairs as directed.
 4. All anchor bolts shall be installed with the tail of bolt hooked over a continuous horizontal bar or an added horizontal bar. Dry pack around void where anchor bolt penetrates masonry face shell.
 5. Fill all masonry cores with grout and immediately consolidate with a mechanical vibrator having a 3/4" head and operating at 5000 RPM submerged.
 6. Pour grout to 1-1/2" below top of masonry unit except at finish course. Immediately remove grout or mortar on exposed faces.
 7. Form construction joints by stopping grout 1-1/2" below top of wall. If work is to be stopped for more than 1 hour, form construction joint with block top surface free of mortar or grout.
 8. At jambs use wood where necessary to hold mortar and grout.
- D. High Lift Grout System: The construction of high lift concrete block masonry work shall conform to the requirements of the California Code of Regulations, Title 24, Part 2 and with the following requirements.
1. Cleanout openings shall be provided for all wall at the bottom of every cell for each pour. The openings shall be made prior to the laying of masonry units and be of sufficient size and location to allow thorough removal of mortar dropping and/or debris.
 2. After the laying of masonry units is completed, the cells cleaned, the reinforcing positioned, and inspection completed, the cleanouts shall be closed by inserting face shells of masonry units or covering the opening with forms. Face shell plugs

shall have a two-day minimum curing time and shall be adequately braced to resist the pressure of the fluid grout.

3. All reinforcing steel inserts and bolts shall be accurately placed in strict accordance with the DSA-approved construction documents. For 8-inch block wall, all horizontal bars shall be placed in a single vertical plane in order to provide for continuous, and unobstructed vertical cells. Both horizontal and vertical reinforcing shall be held in position by wire ties or spacing devices near ends and at intervals not exceeding 192 diameters of the reinforcement.
4. The horizontal reinforcing shall be placed as the work progresses and the vertical reinforcing may be dropped into position after the completion of the laying with positioning devices near the bottom of the wall and at intervals not exceeding 192 diameters.
5. Bond beam units should be used wherever possible and is required at for stacked bond. Use open-end bond-beam units wherever possible to facilitate the horizontal flow of grout Bond beam units are required at all horizontal bars to provide a minimum 3" high by 3" wide vertical opening at all cross webs.
6. All head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Fill all bed joints and full-height cross webs solidly with mortar. Care shall be taken in placing the mortar to keep a minimum of droppings from falling into the block cells. Arrange open-ended concrete masonry units used in stacked bond so that closed ends are not abutting. Consolidate mortar adequately by tooling to form a tight bond with the concrete masonry unit, and to enhance the water resistance of the assemblage. At the time of laying, masonry units shall be free of dust and dirt.
7. When stacked bond is used, or when adequate cross webs between face shells are not provided, ties of heavy gauge wire embedded in the horizontal mortar joints should be provided across continuous vertical joints or between face shells to prevent "blow-outs" due to the hydrostatic pressure exerted by the fluid grout. External ties or braces may also be used for this purpose.
8. During construction the ungrouted walls shall be adequately braced against wind and other forces.
9. Mortar droppings shall not project into the grout space more than 1/4 inch. Remove mortar droppings from the foundation or bearing surface, cell walls and reinforcing steel. An acceptable method is to cover the exposed surface of the foundation with a minimum one inch thick layer of dry sand, and then dislodge any hardened mortar from the cell walls and reinforcement with a pole or rod. Remove mortar debris and the sand cover prior to closing up of cleanouts and grouting.
10. In the high lift grouting method, intermediate horizontal construction joints are not permitted. Grouting shall be completed in one continuous pour of grout to the top

of the high lift portion of the wall in a maximum of four foot layers or lifts in the same working day. Between grout pours , or where grouting has been stopped for more than an hour, grout shall be stopped a minimum of ½ inch below the top of the masonry with a minimum grout cover above the horizontal rebar of 1 inch. An alternate procedure may be use with the approval of the Architect and the DSA.

11. The section of wall to be grouted in any one pour is limited to a length in which successive lifts can be placed within one hour of the preceding lifts. Vertical control barriers shall be placed between pour sections in locations approved by the architect or structural engineer and DSA.
12. Prior to the start of grouting operations, adequate preparations shall be made including but not limited to:
 - a. All cleanout closures, reinforcing steel and embedded items shall be properly secured in place.
 - b. All cells shall be clear and unobstructed. To be considered “unobstructed” all of the following requirements must be met (ref. TMS 402-16):
 - i. For grout pours up to and including twelve feet in height the minimum grout space dimensions of all cells shall be three inches by three inches.
 - ii. For grout pours over twelve feet in height (only permitted for wall with a nominal thickness of twelve inches or more) the minimum grout space dimensions of all cells shall be three inches by four inches.
 - iii. The minimum grout space dimensions of cells containing horizontal reinforcing steel, electrical conduits or any other obstruction shall be increased by the diameter or width of the obstruction.
 - iv. No cell shall contain vertical reinforcing steel exceeding six percent of the cell area.
13. All equipment used for grouting shall be functional, appropriate and adequate for the intended task.
14. An adequate number of vibrators (including at least one spare vibrator to be available if a vibrator breaks down or gets stuck in the wall cavity) shall be available. Vibrators shall be suitable for vibrating the masonry (e.g. small diameter, with a shaft long enough to penetrate into the previous lift as required).
15. Transport grout s from the mixer to the point of deposit in the grout space as rapidly as practical by means and methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry unit surfaces not being immediately encased in the grout lift. Depending upon weather condition and absorption rates of the masonry units, the lift heights and waiting periods may be varied. Under normal weather conditions with typical masonry units the individual lifts of grout shall be limited to five feet four inches (ref. TMS 602-16).

16. The first lift of grout shall be placed to a uniform height within the pour section and mechanically vibrated thoroughly to fill all voids. Vibration shall follow the pouring of the grout and at the same pace as the grouting operation.
17. When the grout is still plastic, pour the succeeding lift and vibrate alternate cells vibrated 12" to 18" into the preceding lift to reconsolidate the preceding lift and close any plastic shrinkage cracks or separations from the cell walls.
18. If due to unavoidable job conditions, it is anticipated the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding lift, each lift shall be reconsolidated by reworking with the vibrator as soon as the grout has achieved its settlement shrinkage.
19. Repeat the waiting, pouring and reconsolidation steps until the top of the pour is reached. The top lift shall also be reconsolidated after the required waiting period and any space lift by settlement shrinkage filled with grout.
20. To reduce the possibility of "blow-outs" do not pour grout until the mortar has set and adequately cured. However, the walls shall be grouted as soon as possible after mortar has cured to reduce shrinkage cracking of the vertical joints.
21. If a "blow-out" occurs and the contractor immediately patches or shores the wall while the grout is still in a fluid state, the contractor shall reconsolidate the grout by mechanical vibration. If the grout achieves its initial set prior to this reconsolidation the zone of damage shall be delineated for removal. The special inspector shall immediately report the extent of the blow-out damage to the project inspector, architect, structural engineer, and DSA, and shall keep record of the blow-out damage and any repair procedures for review by the DSA field engineer.
22. Provisions, such as dry-packing, shall be made to provide solid bedding for nailers at the tops of walls.
23. If equipment breaks down, or any other unforeseen circumstance prevents the grouting operation from proceeding in accordance with these requirements, stop the grout pour until repairs can be made. If any grout does not receive consolidation, or reconsolidation, in a timely manner, the noncompliant area in question shall be clearly delineated and reported. If "cold joints" or non-compliant construction joints result from an emergency interruption of the placing sequence, clearly delineate and report these areas. The architect or engineer in general responsible charge of the project will either propose methods of repair, replacement, additional testing or propose acceptance of the delineated areas. The proposal shall be submitted to DSA for review and approval.
24. Attention shall be give to proper curing of the mortar and grout.

3.4 CLEANING AND FINISHING:

- A. Immediately after the wall has been fully grouted, water pressurized through a jet nozzle shall be used to remove stains which have percolated through the blocks and joints. Water pressure shall be controlled to preclude damage to the wall. Do not use metal bristled brushes.
- B. Repair damaged masonry and fill interstices between masonry and other materials, and fill pin holes, carefully with mortar to match adjoining work.

3.5 WEATHER-SEALING MASONRY:

- A. Prior to sealing: Cure masonry for a period of not less than 28 days and at least 3 days after repairs or tuckpointing. All caulking around masonry shall be in place and cured. Do not apply sealers when surface or air temperatures are less than 40 degrees, masonry is wet or rain is expected within six hours.
- B. Apply first coat of sealer to wall with a low pressure sprayer starting from the bottom up. Flood surface until excess runs down wall 6" to 8" below spray pattern. Within 10 minutes of completing first application, apply second coat, following same procedure. After second application and while still wet, brush wall with soft bristle brush to assure even distribution.

3.6 SPECIAL CONSIDERATIONS:

- A. Notify the Architect at the time when the masonry work is to be started. The Mason shall lay up a section of the building wall approximately 4 feet square. This section shall serve as a sample of the workmanship, tooling and mortar color. Do not proceed further with masonry work until the Architect has approved the sample wall section. The approved section shall serve as standard for the balance of the work.
- B. Protection: Protect top of unfinished work where mortar or grout has not yet set, with water repellent covering.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Architecturally exposed structural steel.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 40 00 – Quality Requirements
3. Section 03 30 00 - Cast-In-Place Concrete.
4. Section 04 22 00 - Concrete Unit Masonry.
5. Section 05 30 00 - Metal Decking.
6. Section 05 50 00 - Metal Fabrications.
7. Section 07 81 16 - Cementitious Fireproofing.
8. Section 09 90 00 - Paints and Coatings.

1.2 REFERENCES

A. CBC-SS/CC Chapter 22A.

B. American Institute of Steel Construction (AISC):

1. AISC – Steel Construction Manual:
 - a. AISC 360 Specifications for Structural Steel Buildings.
 - b. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - c. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.

2. AISC 341 - Seismic Provisions for Structural Steel Buildings, including Supplements.
 3. AISC 358 - Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
- C. American Society for Testing and Materials (ASTM):
1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 4. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 6. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength.
 7. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 Ksi Minimum Tensile Strength.
 8. ASTM A435 - Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
 9. ASTM A490 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 10. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
 11. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 12. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 13. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 14. ASTM A673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel,

15. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
16. ASTM A992 – Standard Specification for Structural Steel Shapes.
17. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
18. ASTM E23 - Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.
19. ASTM E112 - Standard Test Methods for Determining Average Grain Size.
20. ASTM F436 – Standard Specification for Hardened Steel Washers.
21. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
22. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-Ksi Yield Strength.
23. ASTM F1852 – Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tension Strength.

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code - Steel.
2. AWS D1.8 – Structural Welding Code – Seismic Supplement.
2. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination.
3. AWS B2.1 – Specifications for Welding Procedures and Performance Qualification.

E. SSPC – Steel Structures Painting Council:

1. SP-2 - Hand Tool Cleaning.
2. PA-1 - Paint Application Specification No. 1.

1.3 REGULATORY REQUIREMENTS

- A. Structural steel shall conform to CBC-SS/CC requirements, except that steel manufactured by acid Bessemer process is not permitted for structural purposes.

- B. Sheet and strip steel other than those listed in CBC-SS/CC, if provided for structural purpose, shall comply with DSA requirements.

1.4 SUBMITTALS

A. Shop Drawings:

1. Submit Shop Drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar detailing as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked in stresses and distortion; submit sequence and technique plan for review by the Architect.
 - a. Include details of cuts, connections, camber, and holes in accordance with Figure 4.5 of AWS D1.1 or AISC Chapter J, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.
 - b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed for Work specified in other sections.
 - c. Erection and Bracing Plan and Erection Procedure: Submit an erection and framing plan, including columns, beams, and girders, signed and sealed by a Structural or Civil Engineer registered in the State of California in accordance with Title 8 California Code of Regulations, Section 1710, Erection of Structures. Maintain a copy at the Project site as required by the California Division of Industrial Safety.
 - d. Submit a list of steel items to be galvanized.
 - e. Include identification and details of Architecturally Exposed Structural Steel (AESS) members, if applicable.

B. Product Data:

1. Submit copies of fabricator's specifications and installation instructions for the following products. Include laboratory test reports and other data required demonstrating compliance with these Specifications:
 - a. Structural steel, each type; including certified copies of mill reports covering chemical and physical properties.

- b. Welding electrodes.
 - c. Welding gas.
 - d. Unfinished bolts and nuts.
 - e. Structural steel primer paint.
 - f. High-strength bolts, including nuts and washers.
- C. Manufacturer's Mill Certificate:
 - 1. Submit, certifying that products meet or exceed specified requirements.
- D. Mill Test Reports:
 - 1. Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.
- E. Charpy-V-Notch (CVN) Impact Test: Submit certified copies of Charpy-V-Notch (CVN) Impact Test by the manufacturer for applicable steel members and components.
 - 1. Charpy-V-Notch (CVN) Impact Test for Base Metal: Moment frame columns and girders subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part I, Section 6.3, as modified by Supplement 1.
 - 2. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E23.
- F. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured to be fully killed and fine grained having grain size number 5 or better as determined by ASTM E112.
- G. Welding Procedure Specifications (WPS): Submit weld procedures for all welding on project to Owner's testing laboratory for approval. After approval by testing laboratory, submit to Architect for record. Weld procedures shall be qualified as described in AWS D1.5, AISC 341 and AISC 358, as applicable. Weld procedures shall indicate joints details and tolerances, preheat and interpass temperature, post-heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last pass, electrode type and size, welding current, polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged; from these averages the weld heat input shall be calculated. Submit the manufacturer's product data sheet for all welding material used.

- H. Welder's Certificates: Field welders shall be Project certified in accordance with AWS D1.1. Shop welders shall be Project certified for FCAW in accordance with AWS D1.1.
- I. Test Reports: Submit reports of tests conducted on shop and field welded and bolted connections. Include data on type of test conducted and test results.
- J. Welding Material Certification: Provide certificate that welding material complies with specifications. Submit to Owner's testing laboratory.

1.5 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement, except as otherwise indicated:
 - 1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges, modified as follows:
 - a. Replace "Structural Design Drawings" with "Contract Documents" throughout the document.
 - b. Paragraph 3.2 is hereby modified in its entirety as follows:

"Contract Documents including but not limited to architectural, mechanical, plumbing, electrical, civil and kitchen design drawings and specifications shall be used as supplement to the structural plans to define configurations and construction information."
 - c. Delete Paragraph 3.3.
 - d. In Paragraph 4.4, delete the following sentence:

"These drawings shall be returned to the Fabricator within 14 calendar days."
 - e. Delete Paragraph 4.4.1.(a) in its entirety.
 - f. Paragraph 4.4.2 is hereby modified in its entirety as follows:

"No review action, implicit or explicit, shall be interpreted to authorize changes in the Contract Documents."
 - 2. Perform welding in accordance with AWS Standards, AWS D1.1, and California Building Code Section 2004A.1 and approved Weld Procedure Specifications (WPS).
 - 3. Welding for moment frames shall be in compliance with AISC 341 and AISC 358.

- B. Shop fabrication shall be inspected in accordance with CBC-SS/CC.
- C. Erect mock-up panel of fabricated structural steel meeting Architecturally Exposed Structural Steel (AESS) tolerances for exposed areas. Approval by Architect is required. Mock-up to remain for comparison but may not be left as part of the work.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

- A. Stock Materials: Provide exact materials, sections, shapes, thickness, sizes, weights, and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered if net area of shape or section is not reduced thereby, if material and structural properties are at least equivalent, and if overall dimensions are not exceeded.
- B. Shapes, bars, plates, tubes and pipes shall be made of materials with at least 16 percent recycled content if produced from Basic Oxygen Furnace (BOF) or at least 67 percent recycled content if produced from Electric Arc Furnace (EAF).

2.2 MATERIALS

- A. Structural Steel: All wide flange shapes shall conform to ASTM A992 grade 50. Other steel shall conform to ASTM A36.
- B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon bolts and nuts.
- C. High-Strength Threaded Fasteners: ASTM A325, ASTM A490 ASTM F959 or ASTM F1852 quenched and tempered, steel bolts, nuts and washers.
- D. Primers: Lead-free metal primer
 - 1. SSPC-Paint 20, Zinc-Rich Primer.
 - 2. SSPC-Paint 23, Latex Primer.

- 3. SSPC-Paint 25 Zinc Oxide Primer.
- E. Steel Pipe: ASTM A53, Type E or S, Grade B.
- F. Structural Tubing:
 - 1. Hot-formed, ASTM A501.
 - 2. Cold-formed, ASTM A500, Grade B.
- G. Galvanizing: ASTM A123.
- H. Welding Electrodes: Provide electrodes recommended by manufacturer for seismic connections.
 - 1. Comply with AISC 341.
- I. Shear stud connectors: ASTM A108, Grade 1015 forged steel, headed, uncoated, granular flux filled shear connector or anchor studs by Nelson Stud Welding Division, or equal.
- J. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at seven days; of consistency suitable for application and a 30 minute working time.

2.3 FABRICATION

- A. Cleaning and Straightening Materials: Materials being fabricated shall be thoroughly cleaned of scale and rust, and straightened before fabrication. Cleaning and straightening methods shall not damage material. After punching or fabrication of component parts of a member, twists or bends shall be removed before parts are assembled.
- B. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall perform the cutting, punching, drilling and tapping of Work so that Work of other trades will properly connect to steel Work.
- C. Milling: Compression joints depending on contact bearing shall be furnished with bearing surfaces prepared to a common plane by milling.
- D. Use of Burning Torch: Oxygen cutting of members shall be performed by machine. Gouges greater than 3/16 inch that remain from cutting shall be removed by grinding. Reentrant corners shall be shaped notch free to a radius of at least 1/2 inch. Gas cutting of holes for bolts or rivets is not permitted.
- E. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized in largest practical sizes. Fabrication includes operations of

shearing, punching, bending, forming, assembling or welding. Galvanized items shall be free from projections, barbs, or icicles resulting from the galvanizing process.

F. Welding:

1. Type of steel furnished in welded structures shall provide chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the verification and inspection requirements of CBC-SS/CC Chapter 17A. Conform to AWS D1.1, and CBC-SS/CC Chapter 22A.
2. Materials and workmanship shall conform to the requirements specified herein and to CBC-SS/CC requirements, modified as follows:
 - a. No welded splices shall be permitted except those indicated on Drawings unless specifically reviewed by the Architect.
 - b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.
3. Welding shall be performed in accordance with requirements of the AWS Structural Welding Code.
 - a. Welded Joint Details: Comply with AISC 341, AISC 358 and drawing details.
4. Architecturally Exposed Structural Steel: Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds ½ inch and larger. Grind flush butt welds. Dress exposed welds.
5. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Shop Finish:

1. Notify the Project Inspector when Work is ready to receive shop prime coat. Work shall be inspected by the Project Inspector before installation of primer.
2. Structural steel and fittings shall receive a coat of primer, except:
 - a. Surfaces that will be galvanized.

- b. Surfaces that will be fireproofed.
 - c. Surfaces that will be field welded.
 - d. Surfaces in contact with concrete.
 - e. Surfaces high strength bolted.
- 3. The primer specified shall be spray applied, filling joints and corners and covering surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils.
- H. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- I. Fabricate Architecturally Exposed Structural Steel with exposed surfaces smooth, square, and free of surfaces blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
 - 2. Comply with fabrication requirements, including tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for Architecturally Exposed Structural Steel.
- J. Architecturally Exposed Structural Steel: use special care in unloading, handling and erecting the steel to avoid marking or distorting the steel members. Minimize damage to any shop paint when temporary braces or erection clips are used. Avoid unsightly surfaces upon removal. Grind smooth tack welds and holes filled with weld metal or body solder. Plan and execute all operations in such a manner that the close fit and neat appearance of the structure will not be impaired.
- K. Reduced Beam Sections (RBS's): Fabrication of RBS's as defined in AISC 341 and 358.

2.4 SHOP AND FIELD QUALITY CONTROL

- A. A special inspector, approved by DSA to inspect the Work of this section, shall inspect high-strength bolted connections. The Owner will provide a DSA approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC-SS/CC 1704A.3.3. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- B. An AWS CWI certified special inspector, approved by DSA to inspect the Work of this section, shall inspect welded connections in accordance with CBC-SS/CC 1704A.3.1. The Owner will provide a DSA approved independent testing

laboratory to perform tests and prepare test reports. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.

- C. The independent testing laboratory shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.
- D. Provide access to all places where structural steel Work is being fabricated or produced so required inspection and testing can be performed.
- E. The independent testing laboratory may inspect or test structural steel at plant before shipment; however, Architect reserves the right at any time before Contract Completion to deem materials not in compliance with the specified requirements as defective Work.
- F. Correct defects in structural Work when inspections and laboratory test reports indicate noncompliance with specified requirements. Perform additional tests as may be required to reconfirm noncompliance of original Work, and as may be required to show demonstrate compliance of corrected Work.
- G. Inspection of Structural Tube Steel/Hollow Structural Sections (HSS): Structural tube steel members (round, square, rectangular), disregarding steel origin, will be inspected during shop fabrication per DSA Bulletin 07-03. Inspector will perform a visual examination of the seam weld area for visible discontinuities. When defects are suspected, non-destructive testing will be considered.
- H. Welding: Inspect and test during fabrication and erection of structural steel assemblies as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the Work. Record Work required and performed to correct deficiencies.
 - 2. Inspect welds. Welds shall be visually inspected before performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved non-destructive test methods. Testing shall be performed to AWS D1.1 Table 6.3 cyclically loaded non-tubular connections.
 - 3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Repair and test defective welds.
 - 4. Rate of Testing: Completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.

5. Welds, when installed in column splices, shall be tested by either ultrasonic testing or radiography.
 6. Base metal thicker than 1 ½-inch, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities directly behind such welds. Tests shall be performed at least 48 hours after completed joint has cooled down to ambient air temperature.
 7. Material discontinuities shall be reviewed based on the defect rating in accordance with the criteria of AWS D1.1 table 6.3 by the Architect and DSA.
 8. Other method of non-destructive testing and inspection, for example, liquid dye penetrate testing, magnetic particle inspection or radiographic inspection may be performed on weld if required.
 9. Lamellar Tearing: Lamellar-tearing resulting from welding is a crack (with zero tolerance) and shall be repaired in accordance with AWS D1.1.
 10. Lamination: The rejection criteria shall be based on ASTM A435.
 11. Where testing reveals lamination or conditions of lamellar tearing in base metal, the steel fabricator shall submit a proposed method of repair for review by the Architect. Test repaired areas as required.
 12. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 – Qualification.
- I. Lamellar Tearing: Prior to welding plates 1 to 1 ½-inch thick and greater and rolled shapes within the distance from 6 inches above the top of the joint to 6 inches below the bottom of the joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur, members will be reviewed by the Architect and DSA. Welding procedure specifications in sub-section 1.5G specify welding practices to minimize lamellar tearing.
- J. Prior Testing of Base Material: Test material before fabrication.
- K. Lines and levels of erected steel shall be certified by a State of California licensed surveyor as set forth in related Division 01 section.
- L. Welded studs shall be tested and inspected by the special inspector in accordance with requirements of AWS D1.1 – Stud Welding.

- M. Record Drawings: After steel has been erected, correct or revise Shop Drawings and erection diagrams to correspond with reviewed changes performed in the field.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify governing dimensions and conditions of the Work before commencing erection Work.
 - 1. Report discrepancies between drawings and field dimensions to Architect before commencing work.
 - 2. Beginning of installation means erector accepts existing conditions and surfaces underlying or adjacent to work of this section.
- B. Provide temporary shoring and bracing, and other support during performance of the Work. Remove after steel is in place and connected, and after cast-in-place concrete has reached its design strength.
- C. Coordinate prime coat repair and application with requirements of Section 09 9000.

3.2 ERECTION

- A. Install structural steel accurately in locations, to elevations indicated, and according to AISC specifications and CBC-SS/CC requirements.
- B. Clean surfaces of base plates and bearing plates.
 - 1. Install base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims; cut off flush with edge of base or bearing plate before packing with grout.
- C. Maintain erection tolerances of structural steel within AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 1. Architecturally Exposed Structural Steel members and components, plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. Contractor to provide adjustable connections between Architecturally Exposed Structural Steel and the structural steel frame or the masonry or concrete supports, in order to provide the erector with means for adjustment.

- D. Align adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Do not permit thermal cutting during erection of structural steel.
- F. Where indicated for field connections, provide standard bolts complying with ASTM A307.
- G. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with CBC-SS/CC requirements.
 - 1. Allowable hole sizes: 1/16 inch larger than bolt size.
 - 2. Use friction type connection with standard hardened steel circular, square or rectangular washer under bolt nut.
 - 3. Thoroughly clean area under bolt head, nut and washer. Remove all paint, lacquer, oil or other coatings except organic zinc-rich paints in accordance with SSPC, SP-2.
 - 4. Tighten bolts by power torque wrench or hand wrench until twist-off.
- H. Contractor shall be responsible for correcting detailing and fabrication errors and for correct fitting of all members and components.
- I. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide temporary bracing, supports or connections required for complete safety of structure until final permanent connections are installed.
- J. Install column bases within a tolerance of 1/8 inch of detailed centerlines, level at proper elevations. Support bases on double nuts and solidly fill spaces under bases with cement grout.
- K. Provide anchor bolts with templates and diagrams. Contractor shall be responsible for proper location and installation of bolts. Correct deficiencies and errors.
- L. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780.

3.3 FITTING

- A. Closely fit members, finished true to line and in precise position required to allow accurate erection and proper joining in the field.

- B. Drilling to enlarge unfair holes will not be allowed. Allow only enough drifting during assembly to bring parts into position, but not enough to enlarge holes or distort the metal. Do not heat rolled sections, unless approved by Architect.

3.4 PUNCHING AND DRILLING

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

3.5 FINISHING

- A. After erection, spots or surfaces where paint has been removed, damaged, or burned off, and field rivets, bolts, and other field connections shall be cleaned of dirt, oil, grease, and burned paint and furnished with a spot coat of the same primer installed during shop priming.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Install paint to exposed areas with the same material installed during shop painting. Install by brush or spray to provide a minimum dry film thickness of 1.5 mils.

3.6 FIELD QUALITY CONTROL

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

3.7 CLEAN UP

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

3.8 PROTECTION

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

3.9 HANDLING

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

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Wood blocking, cants, and nailers.
 - 5. Wood furring and grounds.
 - 6. Wood sleepers.
 - 7. Plywood backing panels.

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
 - 1. Include data for wood-preservative and fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.
- C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Power-driven fasteners.
 - 5. Powder-actuated fasteners.

6. Expansion anchors.
7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, [mark grade stamp on end or back of each piece] [or] [omit grade stamp and provide certificates of grade compliance issued by grading agency].
 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction[and containing no arsenic or chromium].
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat [items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, [furring,] [stripping,] and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in [AWPA C20 (lumber)] [and] [AWPA C27 (plywood)].
 1. Use Exterior type for exterior locations and where indicated.
 2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
 3. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat [all rough carpentry, unless otherwise indicated.] [items indicated on Drawings, and the following:]
 1. Framing for raised platforms.
 2. Concealed blocking.
 3. Framing for non-load-bearing partitions.
 4. Framing for non-load-bearing exterior walls.
 5. Roof construction.
 6. Plywood backing panels.
 7. <Insert category of rough carpentry items required to be treated.>

2.4 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: [19 percent] [19 percent for 2-inch nominal (38-mm actual) thickness or less, no limit for more than 2-inch nominal (38-mm actual) thickness].
- B. Non-Load-Bearing Interior Partitions: Douglas Fir No. 2 or better.

- C. Framing Other Than Non-Load-Bearing Interior Partitions: Douglas Fir No. 1.
- D. Exposed Framing Indicated to Receive a Stained or Natural Finish: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
 - 1. Species and Grade: Douglas fir-larch; Select Structural WCLIB, or WWP.

2.5 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559[and containing no urea formaldehyde].
 - 1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal- (286-mm actual-) depth members.
 - 2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 700 MPa).
- B. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with **laminated veneer lumber flanges** and wood-based structural panel webs, let into and bonded to flanges. Provide units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.
 - 1. Provide I-joists manufactured without urea formaldehyde.
 - 2. Web Material: Oriented strand board, complying with DOC PS 2, Exposure 1.
 - 3. Structural Properties: Provide units with depths and design values not less than those indicated.
 - 4. Provide units complying with APA PRI-400, factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.
- C. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
 - 1. Material: Product made from laminated veneer lumber. Provide rim boards made without urea formaldehyde.
 - 2. Thickness: 1-1/2-inch or 1-3/4".
 - 3. Provide performance-rated product complying with APA PRR-401, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and [any of] the following species and grades:
 - 1. Mixed southern pine, No. [2] [3] grade; SPIB.
 - 2. Eastern softwoods, No. [2] [3] Common grade; NeLMA.
 - 3. Northern species, No. [2] [3] Common grade; NLGA.
 - 4. Western woods, [Construction or No. 2 Common] [Standard or No. 3 Common] grade; WCLIB or WWP.

2.7 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exterior, C-C Plugged fire-retardant treated as required, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.
- B. Power-Driven Fasteners: NES NER-272.

- C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.9 METAL FRAMING ANCHORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harlen Metal Products, Inc.
 - 2. KC Metals Products, Inc.
 - 3. Simpson Strong-Tie Co., Inc.
 - 4. USP Structural Connectors.
- D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those [indicated] [of basis-of-design products] [of products of manufacturers listed]. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- E. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

2.10 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Self-adhesive, rubberized-asphalt compound, bonded to a high-density, polyethylene film to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate [furring,]nailers, blocking, [grounds,]and similar supports to comply with requirements for attaching other construction.

- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- E. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions and ICC ESR reports.
- F. Do not splice structural members between supports, unless otherwise indicated.
- G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated on DSA approved drawings and complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
 - 4. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

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PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing and installing of all carpentry and related millwork items, as shown and noted on the drawings and as specified. The General Conditions, Changes to the General Conditions Division 1 apply to this section as fully as if repeated herein.

1.2 SUBMITTALS:

- A. Shop Drawings: Submit fully detailed shop drawings of all casework and shelving specified herein for review.
 - 1. Shop drawings shall be prepared in accordance with the North American Architectural Woodwork Standards (NAAWS).
 - 2. Furnish a Woodwork Institute Certified Compliance Label on the first page of the shop drawings.
 - 3. No fabrication or work shall be commenced until shop drawings have been reviewed, approved and returned to the Contractor.
- B. Samples: Submit samples of plastic laminate in colors selected for approval.
- C. Submit catalog information and illustrations for cabinet hardware for approval.

1.1 CERTIFIED COMPLIANCE:

- A. Before delivery to the job site, the woodwork supplier shall provide a Woodwork Institute (WI) Certified Compliance Certificate indicating the millwork products being supplied and Certifying that these products fully meet the requirements of the Grade or Grades specified.
- A. Each elevation of casework, each laminated plastic top, and each solid surface top shall bear a Woodwork Institute Certified Compliance Label.
- C. At completion of installation, the woodwork installer shall provide a Woodwork Institute Certified Compliance Certificate indicating the products installed and certifying that the installation of these products fully meets the requirements of the Grade or Grades specified.

- D. All fees charged by the Woodwork Institute for its Certified Compliance Program are the responsibility of the millwork manufacturer and/or installer and shall be included in their bid.

1.4 HANDLING:

- A. Carefully store all lumber and millwork delivered to the site off the ground in a manner to assure proper drainage, ventilation and protection from dampness.

1.5 GENERAL REQUIREMENTS:

- A. Cooperate with other trades in coordinating their work with the work of this section. Provide all wood grounds, blocking and nailers where indicated or as required for integration of work of other trades into the structure.

PART 2 - PRODUCTS

2.3 GENERAL REQUIREMENTS:

- A. Moisture content at time of placing:
 - 1. Untreated lumber shall not exceed 19 percent.
 - 2. Treated lumber shall not exceed 19 percent, kiln dry after pressure treatment.
 - 3. Plywood shall not exceed 15 percent.
- B. Pressure preservative treatment: AWWPA Standards, using chromated zinc chloride or Wolman Salt (Tanalith). Touch-up parts made raw by cutting or drilling.

2.4 FINISH MATERIALS:

- A. All finish materials under this Section shall conform in every respect to the applicable requirements for "Custom Grade" of the North American Architectural Woodwork Standards, the West Coast Lumbermen's Association, the National Hardwood Lumber Association and the American Plywood Association.
- B. Hardwood shall be red oak except as otherwise noted. Exposed members shall be selected for grain and appearance. Warped members shall not be used. Verify location of all hardwood items.

2.5 LUMBER:

- A. All plates, blocking, backing, and nailers shall be douglas fir-larch No. 2 or Stud grade. Lumber in contact with concrete or masonry shall be pressure treated.

2.6 PLYWOOD:

- A. Backing plywood shall be Douglas fir C-D Interior.
- B. Telephone and Electrical backboards shall be Douglas fir B-D Exterior.
- C. All other plywood, except shelving, shall be Douglas fir Structural I.

2.7 ROUGH HARDWARE:

- A. Furnish all items of rough hardware, connections, bolts, etc., required to complete the work. Bolts, nuts, and washers shall be hot-dipped galvanized, conforming to ASTM A153.
- B. Nails, bolts, washers, nuts, wood screws, lag screws, etc. shall be best suited for their specific condition. Nails shall be steel, common or finished, as required, galvanized when used in exterior conditions or with redwood. Miscellaneous hardware, including metal fittings, where used in exterior conditions and where exposed to the weather, excepting nails, shall be cadmium plated, unless noted otherwise on the Drawings.
- C. Bolts: Standard mild steel, square or hexagonal head machine bolts with matching nuts and cut washers, or carriage bolts with square nuts and cut washers as indicated.

2.8 SHELVING AND STORAGE ITEMS:

- A. Plywood for fixed or adjustable shelving shall be DFPA-INT., A-B, 3/4" or 1" thick as noted. All exposed edges shall have hardwood edge band.
 - 1. Adjustable shelf standards shall be KV #80, or equal.
 - 2. Adjustable shelf brackets shall be KV #180, or equal, of length required.
 - 3. Mop racks, hooks, etc., where indicated on the drawings shall be by KV, Stanley, or equal.

2.9 MISCELLANEOUS ITEMS:

- A. Rough and finish carpentry work and miscellaneous items and their related components which are to be furnished and/or installed under this section are not necessarily individually described. The most important features and those requiring detail description are mentioned. Rough and finish carpentry work and miscellaneous items not mentioned or otherwise described shall be furnished and/or installed in accordance with the intent of the drawings and specifications and as required to complete the work.
 - 1. Hardwood trim shall conform to section 6 of the North American Architectural Woodwork Standards for Custom grade, for transparent finish. Material shall be red oak.

2.10 CASEWORK:

- A. Manufacture plastic laminate faced cabinet work in accordance with AWI, Architectural Woodwork Standards, Section 10, Casework - Laminated Plastic, Custom Grade, except as modified herein.
- B. Manufacture countertops in accordance with North American Architectural Woodwork Standards, Section 11, Laminated Plastic Counter Tops, Splashes, and Wall Paneling, Custom Grade.
- C. Modifications to North American Architectural Woodwork Standards:
 - 1. Plastic Laminate: NEMA LD3 for the following:
 - a. Horizontal Surfaces: NEMA General Purpose Type, nominal 0.050 inch thick.
 - b. Vertical Surfaces: NEMA Vertical-Surface Type, nominal 0.028 inch thick.
 - c. Cabinet Liners: NEMA Cabinet-Liner Type, nominal 0.020 inch thick, or melamine.
 - d. Backing Sheets: Manufacturer's standard backing sheet, nominal 0.020 inch thick.
 - e. Surface Finish: Satin finish, color as selected from manufacturer's full range of colors and patterns.
 - f. Edge Banding. Minimum thickness 3mm.
- D. Counter Tops and Splashes: Plastic Laminate covered, meeting the Custom Grade requirements of North American Architectural Woodwork Standards, Section 11, with coved top to splash joints and exposed edges and ends self-edged, unless otherwise detailed.
- E. Drawer Boxes: Provide with sub-fronts and applied finish fronts securely fastened, with square corners and self-edged. Provide drawers with metal slides except as noted otherwise.
- F. Doors: Flush overlay type, hinged to swing flat against the face of adjoining cabinet or the side of cabinet, with square corners, and self-edged. Do not notch cabinet ends, or divisions to receive hinge.
- G. Shelves: 3/4 inch thick for spans up to 35 inches and 1 inch thick for spans over 35 inches up to 48 inches, and adjustable to 1 inch centers. Do not recess metal shelf standards into the end panels; notch shelving to clear standards.
- H. Cabinet Interiors, including faces and edges of shelving therein, and interior door faces: Finish with cabinet liner. Interiors of open cabinets and cabinets with glass doors shall be finished with plastic laminate, including faces and edges of exposed shelving.

- I. Cabinet Tops: All cabinet tops, regardless of height, shall be covered in plastic laminate including edge banding.
- J. Toe Kick Base: Furnished and installed under section 09 65 00.
- K. Cabinet Hardware:
 - 1. Hinges: Heavy duty wrap-around offset for overlay doors with non-removable pin; flat black or dull chrome finish.
 - 2. Pulls: Surface mounted aluminum, US 28 finish, and one of the following, or equal:
 - 1. Quality #812
 - 2. Trimco #562-3
 - a. Pulls shall conform to CBC Section 11B-309.
 - 3. Catches:
 - a. Doors without locks: Magnetic type and one of the following, or equal:
 - 1. National Lock No. 61-570
 - 2. Stanley No. 41
 - 4. Drawer Slides: Full extension with no deflection, 1/2" slide space, 100 pound load capacity.
 - 5. Adjustable Shelf Standards: One of the following, or equal:
 - a. Knappe & Vogt No. 255 x 256
 - b. Grant No. 125 x 21
 - 6. Door and Drawer Locks: Olympus Lock, Inc., drawer lock No. 600DW, door lock No. 500DR for single doors and active leaf of pairs of doors, 5 pin standard keying. Provide 2 keys for each lock.
 - 7. Metal Strike Plates: Provide cabinet door and drawer locks with metal strike plates.

PART 3 - EXECUTION

3.3 GENERAL:

Before commencing work, check all lines and levels indicated and such other work as has been completed. Should there be any discrepancies, report same in writing to the Architect for correction or adjustment. In event of failure to do so, be responsible for correction of any errors.

3.4 QUALITY ASSURANCE:

- A. All work herein specified, shall be executed by skilled journeymen craftsmen, experienced in the trade, with the proper, sharp tools and in conformity with these documents. Verify all dimensions in the field and all related conditions before starting the work. Inform the Architect of any conflict between locations and conditions of this work and work of others for correction or adjustment. In event of failure to do so, be responsible for correction and any errors.

3.5 INSTALLATION:

- A. Install all work in conformance with the North American Architectural Woodwork Standards (NAAWS), latest edition.
- B. Furring, blocking, and backing shall be furnished and installed where required for formation of architectural features, attachment of supports for building specialties, telephone equipment and other fixtures. Consult with the trades concerned and set furring and blocking they require. Fire-retardant treated wood shall be used for blocking, furring and backing.
- C. All trim shall be fixed in place in full lengths, without piecing, except where use of single lengths would be impractical. Butt joints, if necessary, shall be beveled. Miter all exterior angles. Interior angles of molded parts shall be coped. All exposed nails shall be set for putty with the use of proper setting tool. Where work of this section adjoins and/or abuts work of others, a neat, tight, properly scribed joint shall be the result.
- D. Wherever possible, all materials herein specified shall be worked to completion, in the shop. All parts of fabricated items shall be delivered to the site in as few pieces as possible.
- E. Members which indicate checking or warping shall be rejected. Poor grain combinations shall also be rejected on parts which are to be exposed in the work.
- F. Installation of all assembled items in the work shall be done carefully and neatly. Scribe as required for tight, straight fit. Do not force installation. Shim as required for straight, level and plumb finished surfaces.
- G. Priming and backpainting: Priming and/or backpainting of all finished wood surfaces concealed after installation shall be as specified herein or as required under Section 09 90 00. All priming and backpainting requirements shall be performed before such products are installed in the work. Receive proper inspection of all surfaces before any additional work is started. Laminated casework does not require backpriming.
- H. Protect all parts from injury after installation in the work and maintain said protection until completion of the entire project.

3.6 ROUGH HARDWARE:

- A. Furnish and install all stock items of rough hardware as indicated or required, including clips, anchors, hangers, bolts, ties, and plates for connecting wood framing members to wood, concrete, masonry, or steel, except as specified to be provided under other sections.

3.7 INSTALLATION OF CASEWORK:

- A. Install and anchor all casework work to preclude overturning. Install plumb, level, true and straight with no distortions. Shim as required using concealed shims. Scribe and cut for accurate fit.
- B. Unless otherwise indicated attach casework with #10 cadmium plated ovalhead screws and finish washers at 16 inches on centers.
- C. Install without distortion so that doors and drawers fit openings and are accurately aligned.
- D. Install finish hardware after all finish work has been completed. Inspect drilling operations for surface splinters or delaminations. Pieces bearing such imperfections will be rejected.

3.8 CLEAN-UP:

- A. Take all necessary action to keep this work clean and free of dirt, trash, obstruction and equipment, except that necessary for the proper completion of this work. Materials not used, shall be removed immediately. Dirt and trash shall be cleaned out daily and final clean-up shall leave the work in a thoroughly clean and acceptable condition.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing and installing of thermal and sound insulation in the building as shown and noted on the drawings and as specified herein. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 SUBMITTALS:

- A. Certificates of Conformance: Submit certificates from the manufacturer stating that materials to be furnished meet the R-value requirements specified herein.

1.3 DELIVERY, STORAGE AND HANDLING:

- A. Deliver, store and handle insulation in a manner to prevent damage or deterioration due to moisture, or physical abuse.

1.4 SCHEDULING:

- A. Do not install insulation until construction has progressed to the point that inclement weather will not damage or wet the insulation material. Install insulation after electric wiring, plumbing and other concealed work is in place. Insulation shall not be closed-in until it has been inspected and approved.

PART 2 - PRODUCTS

2.1 BATT INSULATION:

- A. Insulation materials shall be ASTM C 665-17, for mineral wool or glass fiber batts or blankets of the types and R-values specified below for the various applications as manufactured by Manville Building Products Corp., Owens-Corning Fiberglas Corp., U.S. Gypsum Co., Rockwool Industries, Inc or equal.
- B. Sound Insulation in Interior Walls: Unfaced batts designed for friction fit. Flame spread rating not to exceed 25 and smoke density not to exceed 50. Thickness of insulation shall match the thickness of the wall size as noted on the drawings.
- C. Thermal Insulation between Wood Studs in Exterior Walls: Unfaced blankets except where exposed in finished spaces, attic spaces or spaces above suspended ceilings facings shall be fire resistant kraft-foil laminate (flame spread rating not to exceed 25 and smoke density not to exceed 450). R-value shall be not less than R-20.

- D. Thermal Insulation between Wood Joists: Unfaced blankets except where exposed in finished spaces, attic spaces or spaces above suspended ceilings facings shall be flame resistant kraft-foil laminate (flame spread rating not to exceed 25 and smoke density not to exceed 450). R-value shall be not less than R-38.

PART 3 - EXECUTION

3.1 INSTALLATION OF BATT INSULATION:

- A. Installation of batt insulation shall be in accordance with the manufacturer's recommendations. Insulation shall be installed the full height of the wall or between joists, as indicated. Insulation shall be continuous behind all lighting switches, convenience outlet boxes, other devices. All exterior walls and roofs shall be fully and completely insulated to the R-values specified.
- B. Fully insulate small areas between closely spaced framing members.
- C. Do end matching neatly with ends fitting snugly or overlapped.
- D. Cut and fit insulation materials around pipes, conduits, outlet boxes and other obstructions as necessary to maintain the integrity of the insulation. Where pipes are installed in spaces to receive insulation, place insulation between exterior wall and the pipe, compressing insulation if necessary.
- E. Kraft and Foil Faced Blankets: Where insulation is cut to fit small or irregular spaces, form flanges for attachment to framing members. Insert flanged blankets between framing members with facing toward the building interior. Where possible, recess foil faces 3/4" from face of framing members. Staple flanges to joists at the end of each blanket and not more than 6" apart between ends. Maintain kraft or foil facings intact or patch all tears or holes using plastic tape or other approved means.
- F. Unfaced Batts and Blankets: Where insulation is cut to fit small or irregular spaces, cut the insulation slightly larger than the space to ensure a tight friction fit. Insert blankets between the studs from the inside face of the wall, recessed slightly from the face of the studs. Where blankets are not adequately supported by friction, attach the blankets with adhesive, 9/16" long divergent point staples located at four corners and center of each blanket or with tie wires spaced not more than 36" on centers.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

The work includes the furnishing and installing of weather barrier membrane, seam tape, flashing and fasteners as shown and noted on the drawings and as specified. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 REFERENCES:

- A. ASTM International
 1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
 2. ASTM C1193; Standard Guide for Use of Joint Sealants
 3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
 4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
 5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
 6. ASTM E96; Test Method for Water Vapor Transmission of Materials
 7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
 8. ASTM E2178; Test Method for Air Permeance of Building Materials
 9. ASTM E2357; Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- B. AATCC – American Association of Textile Chemists and Colorists
 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test C. TAPPI
 2. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
 3. Test Method T-460; Air Resistance (Gurley Hill Method)

1.3 SUBMITTALS:

- A. Refer to Section 01 33 00 for Submittal Procedures.
- B. Product Data: Submit manufacturer current technical literature for each component.
- C. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inch.
- D. Quality Assurance Submittals
 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.

3. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

1.4 QUALITY ASSURANCE:

A. Qualifications:

1. Installer shall have experience with installation of weather barrier assemblies under similar conditions.
2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.
3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store weather barrier materials as recommended by weather barrier manufacturer.

1.6 SCHEDULING:

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.
- B. Schedule installation of weather barrier materials and exterior cladding within nine months of weather barrier assembly installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

- A. Weather barrier noted and detailed on the drawings and specifications are based on Tyvek Commercial Wrap and related assembly components as manufactured by DuPont.
 1. Acceptable alternate product: James Hardie – HardiWrap
 2. Where meeting the requirements established in this specification alternate products will be considered when submitted in accordance with Section 01 25 00.

2.2 MATERIALS:

- A. Spunbonded polyolefin, non-woven, non-perforated, weather barrier sheet meeting the following performance characteristics:
1. Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2357.
 2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
 3. Water Penetration Resistance: Minimum 280 cm when tested in accordance with AATCC Test Method 127.
 4. Basis Weight: Minimum 2.7 oz/yd², when tested in accordance with TAPPI Test Method T-410.
 5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
 6. Tensile Strength: Minimum 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
 7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
 8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 10, Smoke Developed: 10.
- B. Accessories:
1. Seam Tape: As recommended by the weather barrier manufacturer.
 2. Fasteners:
 - a. 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer.
 - b. Nail Caps: #4 nails with large 1-inch plastic cap fasteners, or 1-inch plastic cap staples with leg length sufficient to achieve a minimum penetration of 5/8-inch into the wood stud.
 - c. Masonry tap-con fasteners with Caps: 2-inch diameter plastic cap fasteners.
- C. Sealants: Refer to Section 07 92 00.
- D. Adhesives: Provide adhesive recommended by weather barrier manufacturer.
- E. Primers: Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.

F. Flashing:

1. Flexible membrane flashing materials for window openings and penetrations recommended by manufacturer.
2. Thru-Wall flashing membrane materials for flashing at changes in direction or elevation (shelf angles, foundations, etc.) and at transitions between different assembly materials.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 INSTALLATION – WEATHER BARRIER:

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
- B. Install weather barrier prior to installation of windows and doors.
- C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level.
- E. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
- F. Window and Door Openings: Extend weather barrier completely over openings.
- G. Overlap weather barrier
1. Exterior corners: minimum 12 inches.
 2. Seams: minimum 6 inches.
- H. Weather Barrier Attachment:
1. Wood & Metal: Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 12-18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

2. Masonry: Attach weather barrier to masonry. Secure using weather barrier manufacturer recommend fasteners, space 12-18 inches vertically on center and 24 inches maximum horizontally. Weather barrier may be temporarily attached to masonry using recommended adhesive, placed in vertical strips spaced 24 inches on center, when coordinated on the project site.

3.3 SEAMING:

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

3.4 OPENING PREPARATION (for use with non-flanged windows - all cladding types)

- A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.

3.5 FLASHING (for use with non-flanged windows - all cladding types)

- A. Cut flexible flashing a minimum of 12 inches longer than width of sill rough opening.
- B. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. Apply 9-inch wide strips of flashing at jambs. Align flashing with interior edge of jamb framing. Start flashing at head of opening and lap sill flashing down to the sill.
- E. Spray-apply primer to top 6 inches of jambs and exposed sheathing.
- F. Install flexible flashing at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
- G. Coordinate flashing with window installation.
- H. On exterior, install backer-rod in joint between window frame and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer's instructions and ASTM C1193.
- I. Position weather barrier head flap across head flashing. Adhere using flashing over the 45-degree seams.
- J. Tape top of window in accordance with manufacturer recommendations.

- K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.6 OPENING PREPARATION (for use with flanged windows)

- A. Cut weather barrier in an "I-cut" pattern. A modified I-cut is also acceptable.
 - 1. Cut weather barrier horizontally along the bottom and top of the window opening.
 - 2. From the top center of the window opening, cut weather barrier vertically down to the sill.
 - 3. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

3.7 FLASHING (for use with flanged windows)

- A. Cut flexible flashing a minimum of 12 inches longer than width of sill rough opening.
- B. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges if necessary.
- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer's instructions.
- F. Apply strips of flashing at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
- G. Apply strip of flashing as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere flashing over the 45-degree seams.
- I. Tape head flap in accordance with manufacturer recommendations.

- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C 1193.

3.8 THRU-WALL FLASHING INSTALLATION:

- A. Apply primer per manufacturer's written instructions.
- B. Install preformed corners and end dams bedded in sealant in appropriate locations along wall.
- C. Starting at a corner, remove release sheet and apply membrane to primed surfaces in lengths of 8 to 10 feet.
- D. Extend membrane through wall and leave ¼ inch minimum exposed to form drip edge.
- E. Roll flashing into place. Ensure continuous and direct contact with substrate.
- F. Lap ends and overlap preformed corners 4 inches minimum. Seal all laps with sealant.
- G. Trim exterior edge of membrane 1-inch and secure metal drip edge per manufacturer's written instructions.
- H. Apply sealant bead at each termination.

3.9 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT BASE OF WALL:

- A. Overlap thru-wall flashing with weather barrier by 6-inches.
- B. Mechanically fasten bottom of weather barrier through top of thru-wall flashing.
- C. Seal vertical and horizontal seams with tape or sealing membrane.

3.10 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT SHELF ANGLE:

- A. Seal weather barrier to bottom of shelf angle with sealing membrane.
- B. Apply thru-wall flashing to top of shelf angle. Overlap thru-wall flashing with weather barrier by 6-inches.
- C. Seal bottom of weather barrier to thru-wall flashing with tape or sealing membrane.

3.11 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT WINDOW HEAD:

- A. Cut flap in weather barrier at window head.
- B. Prime exposed sheathing.

- C. Install lintel as required. Verify end dams extend 4 inches minimum beyond opening
- D. Install end dams bedded in sealant.
- E. Adhere 2 inches minimum thru-wall flashing to wall sheathing. Overlap lintel with thru-wall flashing and extend $\frac{1}{4}$ inch minimum beyond outside edge of lintel to form drip edge.
- F. Apply sealant along thru-wall flashing edges.
- G. Fold weather barrier flap back into place and tape bottom edge to thru-wall flashing.
- H. Tape diagonal cuts of weather barrier.
- I. Secure weather barrier flap with fasteners.

3.12 PROTECTION:

- A. Protect installed weather barrier from damage.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing and installing of sealant work required to weatherproof the buildings, including interior sealant work. This section contains requirements pertaining to all weather and interior sealing throughout the project and becomes a part of each section calling for sealing and caulking.
- B. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 REFERENCES:

- A. The editions of American Society for Testing Materials (ASTM) Standards referenced herein apply to the work only to the extent specified by the reference thereto.

1.3 SUBMITTALS:

- A. Product Data: Submit copies of manufacturer's specifications, recommendations and installation instructions for each type of sealant and related material required.
 - 1. Include manufacturer's letter of certification, or certified test reports indicating that each material complies with the requirements specified herein and is suitable for the applications indicated.
 - 2. Include manufacturer's letter of certification indicating that sealants, primers and cleaners comply with regulations controlling use of volatile organic compounds.
- B. Samples: Submit samples indicating the color range available for each sealant material intended for installation in locations exposed to view. Materials installed before approval of color will be subject to removal and replacement with approved material.
- C. Submittal procedures and quantities are specified in Section 01 33 00.

1.4 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Obtain joint sealants from a single manufacturer for each different product required. Obtain elastomeric sealants only from manufacturers who will, if required by the Architect, send a qualified technical representative to the project site to advise the installer of proper procedures and precautions for the use of these materials.

- B. Installer's Qualifications: Employ a firm having a minimum of 5 years successful experience in the application of the type materials required.
- C. Regulatory Requirements. The quantity of volatile organic compounds (VOC) used in sealants, primers and cleaners shall not exceed the limits permitted under the current regulations for architectural coatings of the South Coast Air Quality Management District.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver sealants to the site in unopened containers, labeled with the manufacturer's name, brand designation, color, expiration period for use, pot life curing time, and mixing instructions for multicomponent materials.
- B. Store sealants in an area where they will not be subject to temperatures above 100 degrees F or below 40 degrees F. Do not store materials that have exceeded the manufacturer's recommended shelf life.

1.6 JOB CONDITIONS:

- A. Do not apply sealants when the ambient temperature is above 100 degrees F or below 40 degrees F or when weather is foggy, or rainy.

1.7 WARRANTY:

- A. In addition to the warranty and correction of work requirements of the General Conditions, work under this section shall be warranted against moisture penetration for a period of 5 years from the date of "Notice of Completion". The written warranty shall include materials and labor required to repair leaks that develop. The warranty shall be signed by the sealant manufacturer, the sealant installer and the Contractor and shall be submitted in accordance with Section 01 77 00.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Type A Sealant: Multiple component, self-leveling polyurethane based sealant meeting the requirements of ASTM C-920, Type M, Grade P, Class 25. Acceptable products, or equal:
 - 1. Tremco; "Vulkem 245"
 - 2. Pecora Corp.; "Urexpan NR-200"
 - 3. Sika Corp.; "Sikaflex-2c-SL"
 - 4. Sonneborn Building Products; "Sonolastic SL 2"
- B. Type B Sealant: Single or multiple component, nonsag polyurethane based sealant meeting the requirements of ASTM C-920, Type S or M, Grade NS, Class 25. Do not

use single component sealants when excessive movement is expected within the curing time of the sealant. Acceptable products, or equal:

1. Tremco; "Vulkem 116 or 227"
 2. Pecora Corp.; "Dynatrol I or II"
 3. Sika Corp.; "Sikaflex 1a or 2C-NS"
 4. Sonneborn Building Products; "Sonolastic NP 2"
- C. Type C Sealant: Butyl rubber based sealant meeting the requirements of ASTM C-920, Type S, Grade NS, Class 7.5. Acceptable products, or equal:
1. Adco Seal; "No. B-100"
 2. Pecora Corp.; "BC-158"
 3. H.B. Fuller; "PTI 757"
 4. Tremco; "Butyl Sealant"
- D. Type D Sealant: Latex acrylic based sealant meeting the requirements of ASTM C834. Acceptable products, or equal:
1. Pecora Corp.; "AC-20"
 2. Sonneborn Building Products; "Sonolac"
 3. Tremco; "Acrylic Latex 834"
- E. Type E Sealant: Low modulus silicone sealant meeting the requirements of ASTM C-920, Type S, Grade NS, Class 50. Acceptable products, or equal:
1. Dow Corning Corp.; "Silicone Building Sealant 795"
 2. Pecora Corp.; "864 Silicone"
 3. Sonneborn Building Products; "Sonolastic Omniseal"
 4. Tremco; "Spectrem 2"
- F. Type F Sealant: Narrow joint seam sealant meeting the requirements of AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width. Acceptable products, or equal:
1. H.B. Fuller; "PTI 200"
- G. Acoustical Sealant: Sealant shall be one of the following at the Contractors option.
1. Polyvinyl chloride foam tape with pressure sensitive adhesive on one side 3/4 inch wide by the thickness required to accommodate unevenness of substrates and completely fill openings between building floors and walls. Acceptable products, or approved equal:
 - a. Norseal LTD; "Norseal V730 Series"
 2. Permanently resilient compound manufactured specifically for acoustical applications. Acceptable products, or equal:

- a. Tremco; "Acoustical Sealant"
- b. Hinkle Corporation; "SC 170 (Solvent Base)"

I. Colors: Provide custom colors as selected by the Architect. In general, colors shall be as follows:

Concrete flatwork	To match concrete.
Concrete walls	To match concrete.
Masonry walls	To match mortar color.
Aluminum to concrete	To match concrete.
Aluminum to aluminum	To match aluminum color.
Ceramic tile	To match grout.
Other locations	To match color of adjacent surface.

2.2 MISCELLANEOUS MATERIALS:

- A. Joint Filler: Preformed, compressible, resilient, nonstaining polyurethane, open or closed cell non-outgassing foam, round in shape, with diameter never less than 30% greater than width of joint. Sealant manufacturer shall guarantee filler as being suitable for its intended use and entirely compatible with the sealant.
- B. Primer, as required: Product of manufacturer of sealant used.
- C. Lacquer Sealer: Clear, as recommended by sealant manufacturer.
- D. Bond Breaker Tape: shall be polyethylene tape or other tape as recommended by the sealant manufacturer. Provide self-adhesive tape wherever applicable.

PART 3 - EXECUTION

3.2 EXAMINATION:

- A. Examine the joint surfaces, backing, and anchorages of units forming sealant rabbet, and the conditions under which the sealant work is to be performed for conditions that would adversely affect the performance of the sealant. Do not proceed with the sealant work until unsatisfactory conditions have been corrected. Start of sealant work constitutes acceptance of conditions.

3.3 SURFACE PREPARATION:

- A. Surface Cleaning of joints: completely clean joints and spaces to be sealed of all dirt, dust, mortar, oil, and other foreign materials which might adversely affect the joint sealing work. Prepare surfaces to receive sealant to conform to the sealant manufacturer's specifications
- B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer. Apply primer to comply with joint sealant manufacturers'

recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.4 JOINT DIMENSIONS:

- A. Butyl-Base Type Sealant: Minimum joint width of 1/4 inch, and depth of three times the width of the joint, with the maximum depth 3/4 inch.
- B. Silicone Rubber, Acrylic and Polyurethane Sealant: Width-to-depth ratios shall conform to the following:

IF JOINT WIDTH is:

JOINT DEPTH shall be:

For Non-Porous Surfaces:

1/4" (minimum)

1/4" to 1/2"

over 1/2"

Minimum

1/4"

1/2 of width

NOT PERMITTED

Maximum

1/4"

Equal to width

For Porous Surfaces:

1/4" (minimum)

1/4" to 1/2"

1/2" to 1"

Over 1"

1/4"

1/4"

1/4"

NOT PERMITTED

1/4"

Equal to width

Equal to width

3.5 SEALANT APPLICATION SCHEDULE:

- A. Type A Sealant: Use for all joints in exterior and interior concrete and ceramic tile floors and paved surfaces subject to foot traffic.
- B. Type B Sealant: Use for all vertical joints in masonry, plaster and concrete, exposed on the exterior of the building and for sealing around metal door, window and louver frames penetrating these surfaces.
- C. Type C Sealant: Use for interior wall penetrations for pipe or conduit that will be concealed by escutcheons or other trim or plates and for lap joints in sheet metal work.
- D. Type D Sealant: Use for joints, voids, and penetrations in interior surfaces exposed to view and requiring painting.
- E. Type E Sealant: Use for all joints in contact with organically coated aluminum.
- F. Type F Sealant: Use for all narrow joints in aluminum storefront framing where joints are mechanically restricted from movement.
- G. Acoustic Sealant: Use to seal all perimeter joints around sound retardant partitions and around electrical boxes and other penetrations in these partitions.

3.6 APPLICATION:

- A. Installation of Sealant Filler: Install sealant fillers to provide support for sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths as specified herein and to allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint filler.
 - 2. Do not stretch, twist, puncture, or tear joint fillers.
 - 3. Remove absorbent joint fillers that have become wet before sealant application and replace with dry material.
 - 4. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- B. Install sealants in compliance with the details, square and perpendicular to the adjoining surfaces. Rounded off finishing will not be allowed.
- C. Seal around all openings in exterior walls, and other locations indicated or required for waterproofing the buildings. Seal all other joints as herein specified, indicated, and required to properly complete the building(s).
- D. Apply sealants using specified materials and proper tools. Prepare surfaces and apply sealant as specified herein and in accordance with the manufacturer's printed instructions and recommendations.
- E. Apply sealants with guns having proper size nozzles. Use sufficient pressure to fill all voids and joints solid. In sealing around openings, include entire perimeter of each opening, unless indicated or specified otherwise.
- F. Neatly point sealed joints on flush surfaces with beading tool. Remove excess material. Sealant, where exposed, shall be free of wrinkles and uniformly smooth. Complete sealing before final coats of paint are applied.

3.7 MISCELLANEOUS JOINT AND SEALING WORK:

- A. The entire extent of sealing work is not necessarily fully or individually described herein. Sealing shall be provided wherever required to prevent light leakage as well as moisture leakage. Refer to drawings for conditions and related parts of the work.

3.8 CLEANING:

- A. Clean surfaces of all materials adjoining sealed joints of any smears of sealant or other soiling due to sealant application.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Hollow metal doors
 - 2. Hollow metal frames
 - 3. Hollow metal architectural stick systems
- B. Exclusions: Metal for the following is not provided under the scope of this section:
 - 1. Structural steel
 - 2. Headers and lintels
 - 3. Framing
 - 4. Steel channel frames
 - 5. Access panels
- C. Related Sections:
 - 1. Division 07 Section "Joint Sealants"
 - 2. Division 08 Section "Door Hardware"

1.3 REFERENCES

- A. Fire/Life Safety
 - 1. NFPA - National Fire Protection Association
 - a. NFPA 70 – National Electric Code
 - b. NFPA 80 - Standard for Fire Doors and Fire Windows

- c. NFPA 101 - Life Safety Code
 - d. NFPA 105 - Smoke and Draft Control Door Assemblies
- 2. State Fire Safety Code.
- B. UL - Underwriters Laboratories
 - 1. UL 10C - Positive Pressure Test of Fire Door Assemblies
 - 2. UL 1784 - Air Leakage Tests of Door Assemblies
- C. Accessibility
 - 1. ADA - Americans with Disabilities Act.
 - 2. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- D. SDI – Steel Door Institute
 - 1. SDI 100 - Recommended Specifications - Standard Steel Doors and Frames.
 - 2. SDI 105 - Recommended Erection Instructions for Steel frames.
 - 3. SDI 111 - Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
 - 4. SDI 112 - Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
 - 5. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
 - 6. SDI 118 - Basic Fire Door Requirements.
 - 7. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 - 8. SDI 124 - Maintenance of Standard Steel Doors and Frames.
- E. DHI - Door and Hardware Institute
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
- F. ANSI - American National Standards Institute
 - 1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

2. ANSI A250.3-2001 - Test Procedure and Acceptance Criteria for - Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
 3. ANSI A250.4-2001 - Test Procedure and Acceptance Criteria for - Physical Endurance for Steel Doors, Frames, Frame Anchors, and Hardware Reinforcings.
 4. ANSI A250.6-2003 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 5. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames
 6. ANSI A250.10-1998 - Test Procedures and Acceptance Criteria for – Prime Painted Steel Surfaces for Steel Doors and Frames.
 7. ANSI A250.11-2001 - Recommended Erection Instructions for Steel Frames.
- G. ASTM - American Society for Testing and Materials
1. ASTM-A1008/A1008M-00 - Specification for Commercial Steel (CS) Sheet, Carbon, Cold-Rolled.
 2. ASTM-A568/A568M - Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled.
 3. ASTM-A653/A653M - Specification for Steel Sheet, Zinc-Coated or Zinc-Iron Alloy-Coated by the Hot Dip Process.
 4. ASTM-A36/A36M-05 - Standard Specification for Carbon Structural Steel.
 5. ASTM C1363-11 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
 6. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
 7. ASTM E 413 - Classification for Rating Sound Insulation.

1.4 SUPPLIER QUALIFICATIONS

- A. Hollow Metal Supplier shall maintain at the location which will be managing the project, a credentialed Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) as a full-time employee, and member in good standing of DHI - Door Security + Safety Professionals.
- B. Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) shall supervise other individuals employed by the Door and Frame Supplier who work on the project and be available throughout the project to meet with the Contractor, Architect or Owner as needed.

- C. Failure to meet the above requirements will disqualify the bidder.
- D. The Owner may visit the Supplier's office and warehouse to observe if the intent of the requirements set forth in the specifications have been met.

1.5 SUBMITTALS

A. General:

- 1. Submit the following in accordance with conditions of contract and Division 01 requirements.
- 2. Advise Architect within the submittal package of incompatibility or issues which may detrimentally affect the work of this section.
- 3. Prior to forwarding submittal: Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

- 1. Product Data: Provide illustrations from manufacturer's catalogs and data in brochure form for all products, including model, function, design, finish, and options.
- 2. Samples for Verification: If requested by the Architect, submit production samples or sample installations of each type of frame joining corners and butt details, door cores and edge constructions, and finish sample, tagged with a full description for coordination with the schedule.
- 3. Door Hardware Schedule: Organize schedule into spreadsheet format indicating complete designations of every item required for each door and frame. Door and frame schedule shall clearly indicate architect's door number, elevations, and notes:
- 4. Templates: After final approval of the door and frame schedule, provide listing of manufacturer's hardware locations for each item of hardware.

C. Informational Submittals:

- 1. Qualification Data: For supplier, installer and Certified Door Consultant.
- 2. Product Certificates for hollow metal doors and frames, signed by the manufacturer:
 - a. Certify that hollow metal doors and frames are approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:

- a. Certificates of compliance for fire-rated doors and frames and installation instructions shall be made available upon request of Architect or authority having jurisdiction.
- b. Submit manufacturer certification that doors and frames have been tested and comply with ANSI-A250.4, Level "A", 1,000,000 cycle test criteria and other requirements as listed in these specifications.
- c. Submit manufacturer certification that fire rated doors and frames comply with NFPA 252 and UL10C, Category "A", Positive Pressure Fire Test of Door Assemblies.

4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for doors and frames located in accessible routes.

5. Warranty: warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include the following:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement.
- b. Catalog pages for each product.
- c. Name, address, and phone number of local representative for each manufacturer.
- d. Copy of final approved door and frame schedule, edited to reflect conditions as-installed.
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.

1.6 QUALITY ASSURANCE

A. Product Substitutions: For the purpose of performing the work of this section, comply with product requirements stated in Division 01 and as specified herein.

- 1. Where a specific manufacturer's product is named and accompanied by the words "No Substitute," including make or model number or other designation, provide the product exactly as specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)

- a. Where no additional products or manufacturers are listed in a product category, requirements for “No Substitute” govern product selection.
 2. Where products indicate “acceptable substitute” or “acceptable manufacturer”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.
- B. **Supplier Qualifications and Responsibilities:** A recognized hollow metal door and frame supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying hollow metal doors and frames similar in quantity, type, and quality to that indicated for this project and that provides a Certified Door Consultant (CDC) available to the Owner, Architect, and Contractor, at reasonable times during the course of the work for consultation.
1. Warehousing Facilities: In project's vicinity.
 2. Scheduling Responsibility: Preparation of hollow metal door and frame schedules.
 3. Engineering Responsibility: Preparation of data for field spliced or field modified units, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this project.
 4. Coordination Responsibility: Coordinate preparation of the door hardware and provide installation and technical data to the Architect and other related subcontractors.
 - a. Upon completion of hollow metal door and frame installation, inspect and verify that all components are working properly.
- C. **Installer Qualifications:** Qualified tradesmen, skilled in the application of hollow metal doors and frames that has a record of successful in-service performance for installing hollow metal doors and frames similar in quantity, type, and quality to that indicated for this project.
- D. **Certified Door Consultant Qualifications:** A person who is experienced in providing consulting services for commercial doors that are comparable in material, design, and extent to that indicated for this project and who can meet the following qualification requirements:
1. For door hardware, DHI-certified, Certified Door Consultant (CDC).
 2. Can provide installation and technical data to the Architect and other related subcontractors.

3. Can inspect and verify components are in working order upon completion of installation.
- E. Single Source Responsibility: Obtain each type of hollow metal door and frame from a single manufacturer.
- F. Fire-Rated Openings: Provide doors and frames for fire-rated openings that complies with NFPA Standard No. 80, NFPA 252 or UL10C, Category “A”, Positive Pressure Test of Fire Door Assemblies, and requirements of authorities having jurisdiction. Provide only doors and frames that are labeled and listed for ratings indicated by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to the authorities having jurisdiction.
1. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.
 2. Temperature Rise Rating: Provide doors that have temperature rise rating of 450 degrees F (232C) or 250 degree F (121 C) maximum in 30 minutes of fire exposure in accordance with local building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Tag each item or package separately with identification related to the final door and frame schedule, and include installation instructions with each delivery.
- B. Project Conditions:
1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - a. Door Storage: Store doors in upright position, under cover. Place doors on at least 4 inch high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove all packaging immediately. Provide 1/4 inch (6.3) space between doors to promote air circulation.
 - b. Frame Storage: Store frames under cover on 4 inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4 inch space between frames to promote air circulation.
- C. Protection and Damage:

1. Promptly replace products damaged during shipping with exactly the same products.
2. Handle doors and frames in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during the course of the Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

1.8 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. See Division 03 for concrete, reinforcement, and formwork requirements.
- B. Coordinate hardware mounting heights as specified under Section 087100.
- C. Installation: Check shop drawings of other work to confirm that adequate provisions are made for locating and installing doors and frames to comply with indicated requirements.
- D. Electrical System Roughing-In: Coordinate layout and installation of doors and frames with electrified door hardware connections.

1.9 WARRANTY

- A. Provide manufacturer's warranties as specified in Division 01 and as follows:
 1. Hollow Metal Doors and Frames: 1 year.
 2. Warranty does not cover damage or faulty operation due to improper installation, improper use, or abuse.

1.10 MAINTENANCE

- A. Maintenance Instructions: Furnish a complete set of maintenance instructions as needed for Owner's continued maintenance of doors and frames.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as, "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each door and frame for proper installation and operation of door movement as shown.

- C. Where the door and frame specified is not adaptable to accept the finish hardware specified, furnish suitable type having the same operation and quality as the type specified, subject to the Architect's approval.

2.2 MATERIALS

A. Fasteners

- 1. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide manufacturers standard screws. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with manufacturer's standard self-tapping screws.

2.3 HOLLOW METAL FRAMES

A. Manufacturer:

- 1. Scheduled Manufacturer: Steelcraft.
- 2. Acceptable Substitute: DCI, Republic.

B. Performance Requirements:

- 1. Provide hollow metal frames as scheduled, and drawn and detailed on plans, with the provisions below.
- 2. Cold Rolled Steel Sheets: Commercial quality, stretcher-leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM-A1008/A1008M-00 and ASTM-A568 general requirements.
- 3. Galvannealed Steel Sheets: ASTM-A653, A60 zinc coating. Use galvannealed steel sheets for exterior hollow metal frames. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
- 4. Minimum gages of hollow metal frames are specified below in compliance with SDI 100/ANSI A250.8. Provide heavier gage if required by code, details, specific condition, or to meet specified standards. Entire frame and sidelight shall be of same gage. Frames must have been tested and comply with ANSI-A250.4, Level "A", 1,000,000 Cycle Test Criteria.
 - a. Level 4 (14 gage) Galvannealed: Exterior frames.
- 5. Steel Reinforcing: Meeting ASTM-A36/A36M-14 – Standard Specification for Carbon Structural Steel.
- 6. General: Form to profiles indicated. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.

2.4 HOLLOW METAL DOORS AND PANELS – FLUSH TYPE

A. Manufacturer:

1. Scheduled Manufacturer: Steelcraft.
2. Acceptable Substitute: DCI, Republic.

B. Performance Requirements:

1. Provide flush hollow metal doors as scheduled, and drawn and detailed on plans, with the provisions below.
2. Cold Rolled Steel Sheets: Commercial quality, stretcher-leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM-A1008/A1008M-00 and ASTM-A568 general requirements.
3. Galvannealed Steel Sheets: ASTM-A653, A60 zinc coating. Use galvannealed steel sheets for exterior flush hollow metal doors with smooth non-wood grain surface and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
4. Minimum gages of flush hollow metal doors are specified below in compliance with SDI 100/ANSI A250.8
5. Doors must have been tested and comply with ANSI-A250.4, Level “A”, 1,000,000 Cycle Test Criteria.

C. Exterior Doors: 14 gauge. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical performance level.

1. Level 4, Model 2 (seamless edge), physical performance level A (maximum duty)

D. Fabrication:

1. Anchorage: Provide a minimum of three (3) anchors per jamb up to 84 inches high. For longer jambs, provide sufficient anchors to permit maximum spacing of 24 inches on center. Provide welded anchors at welded frames unless detailed or noted otherwise. Provide standard and special anchorage items as required. At masonry jambs provide wire anchors. Provide 16 gage angle clips welded in place at bottom of each jamb with two punched holes for securing frames to floor. Where dictated by fire rating testing laboratory procedures, supply anchors complying with such requirements. All frames shall be provided with two temporary steel spreaders welded to the feet of the jambs to serve as bracing during shipping and handling only. These shall be removed prior to installation and are not to be used for setting of proper frame tolerances.

2. Extensions: Reinforce transom bars or mullions as necessary to provide rigid installation.
3. Mullions: Provide mullions straight and without twist of tubular design. For removable mullions provide fastenings of non-ferrous bolts at bottom, with sleeves at head of frame for mullion to clip over.
4. Clearances: Provide proper clearances at metal frames, including for glass/glazing, gasketing, and sound stripping.
5. Glass Stops: Where specified or indicated on drawings, frames shall be supplied with removable glass moldings. These shall be formed "U" shaped steel of the same gage as the frame. All stops shall have tightly fitted butted or mitered corners and shall be secured with manufacturer's standard self-tapping screws no more than 10 inches on center or as required, on fire rated frames, by manufacturers labeling authority.
6. Hospital Stops: Where shown or noted on drawings except at frames for lead-lined doors, doors in 2-hour fire rated partitions, and one hour smoke and fire rated partitions, stops shall be cut at 5-1/2 inches above floor with 45 degree miter and welded closed.
7. Labeled Frames: Construct in accordance with requirements for labeled work. Attach proper metal U.L. or Warnock Hersey label. "B" labeled frames shall be 1-1/2 hour construction. Embossed labels are not acceptable.
8. Steel Reinforcing: Meeting ASTM-A36/A36M-14 – Standard Specification for Carbon Structural Steel.
9. Provide to design indicated including: Flush panel doors, cut-outs as indicated, lite kits, and/or door louvers. Use galvanized steel at exterior doors.
10. Flush Doors: Reinforce, stiffen and sound deaden. Provide steel inverted closure at top of doors. Provide manufacturers standard screwed-in steel top cap at exterior doors, except at doors with concealed overhead stops.

E. Cores:

1. Exterior Doors: 20 gage steel stiffener reinforced vertically 6 inches apart full height and width, stitch welded 6 inches on center to both face sheets. Insulate and sound deaden with fiberglass insulation complying with ASTM C1363 with a minimum operable R-Factor of 1.45.

F. Labeled Doors: Mark as required by Underwriters Laboratories or Warnock Hersey. Build in special hardware reinforcements and provide astragals as required.

G. Vertical Edges:

1. Vertical Edges: Doors shall be Model 2 seamless stitch welded and filled. Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Door edge seams shall be stitch welded with 1-inch welds every 4 to 6 inches on center, ground smooth, epoxy filled flush, and finished.

2.5 FINISHES

- A. Frames: Clean frames by degreasing process and apply thorough coating of baked-on shop primer conforming to ANSI A250.10, covering inside as well as outside surfaces. After welding, grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Coat welds and other disrupted surfaces with manufacturer's standard rust inhibiting primer conforming to ANSI A250.10.
- B. Doors: Thoroughly clean off rust, grease and other impurities. Grind welds smooth, allowing no marks to show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Apply thorough coating of manufacturer's standard rust inhibiting shop primer conforming to ANSI A250.10.

2.6 ACCESSORIES

- A. Louvers: Provide 1 inch thick inverted "Y" blade type louvers that are inserted into an opening prepared in the door faces. Louver blades shall be fabricated from 18 gage cold-rolled steel and welded to a fabricated sub-frame. The louver is held in place by a retaining frame or shroud furnished with the louver.

2.7 FABRICATION

- A. Fabricate doors and frames in accordance with requirements of ANSI A250.8-2003/SDI 100.
- B. Fabricate fire rated doors in accordance with requirements of ITS – Warnock Hersey or Underwriters' Laboratories, with metal label on each door and frame including NFPA 252 or UL-10C Category "A".
- C. Typical Frame Reinforcing: Provide steel reinforcement as required for hardware items per manufacturers templates. Provide minimum hinge reinforcement 9 gage by 1-1/2 inch by 9 inch and lock strike reinforcement 16 gage 1 inch by 1-1/2 inch by 4 inch long. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 14 gage, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head door closers and mortised locks. Reinforcing as provided for in ANSI-A250.6.
- D. Mortar Guards in Frames: For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.

- E. Hardware Preparation at Frames: Mortise, reinforce, drill and tap as required for all mortised hardware furnished under Division 8 Finish Hardware and/or Division 26 Security in accordance with a final approved hardware schedule and templates provided by the hardware supplier and/or security supplier (including electric hinges and/or power transfers, door position switches, and other electrified hardware). Drilling and tapping for surface door closers, door closer brackets, and adjusters shall be done in field by hardware installer. Provide metal mortar guards for all mortised cutouts for frames in masonry walls and/or frames being grout filled. Obtain templates from hardware and security suppliers. Provide hardware preparation per ANSI-A250.6.
- F. Joining at Frames: At frames with equal width jambs and head, neatly miter on face and cope and butt stops. At other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly. Weld length of entire frame faces and grind smooth. Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints. Joints shall be finished and primed.
- G. Provide bevel lock edge of single acting swinging doors 1/8 inch in 2 inches. Provide radius edge of double acting swing doors as required by pivot hinge manufacturer. Provide square edge on sliding doors and panels.
- H. Typical Door Reinforcement: Provide steel reinforcement as required for hardware items per manufacturers' templates. Provide 7 gage steel hinge reinforcements. Provide 16 gage steel lock reinforcements, and 14 gage steel channel or box type closer reinforcement minimum 6 inches high and 20 inches long. Projection weld hinge and lock reinforcements to the edge of the door. Provide adequate reinforcements for other hardware as required. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface overhead holders and stops. Reinforcing as provided for in ANSI-A250.6.
- I. Hardware Preparation at Doors: Mortise, reinforce, drill and tap as required for all mortised hardware furnished under Division 08 Finish Hardware and/or Division 28 Access Control in accordance with a final approved hardware schedule and templates provided by the hardware supplier and/or security supplier (including a minimum 1/2 inch raceway for electrical hardware, electric hinges and/or power transfers, door position switches, and other electrified hardware). Drill and tap for surface door closers, door closer brackets, and adjusters in field. Obtain templates from hardware and security suppliers. Provide hardware preparation per ANSI-A250.6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of any doors and frames, examine supporting structure and conditions under which hollow metal doors and frames are to be installed. Correct all defects prior to proceeding with installation.

3.2 INSTALLATION

- A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship. Set hollow metal plumb, level, square to proper elevations, true to line and eye. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.
- B. Placing Frames: Remove manufacturer's shipping spreader-bars prior to installation. These shall not be used for setting of proper frame tolerances. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set in accordance with ANSI A250.11. After wall construction is complete, remove temporary braces and/or installation spreaders leaving surfaces smooth and undamaged. In masonry construction, building-in of anchors and grouting of frames with mortar is specified in Division 04 Section - Unit Masonry. At in-place concrete or masonry construction, set frames and secure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.
- C. Place fire-rated frames in accordance with NFPA 80, and/or manufacturers' follow-up procedure requirements.
- D. Door Installation: Fit hollow metal doors accurately in their respective frames, within following clearances: Jambs and head 1/8 inch, meeting edges pair of doors 1/8 inch, sill where no threshold or carpet 1/4 inch above finished floor, sill at threshold 3/4 inch maximum above finished floor, sill at carpet 1/4 inch above carpet. Place fire-rated doors with clearances as specified in NFPA 80.

3.3 FIELD QUALITY CONTROL

- A. After installation of frames has been completed, a qualified person from the hardware installation company is to check the project to confirm the proper installation of frames to allow for the proper installation of doors and finish hardware scheduled.
- B. Installer shall deliver to owner, upon completion, one set of installation and maintenance instructions for doors and frames.

3.4 ADJUSTING

- A. Final Adjustments: Adjust doors and hardware prior to final inspection and acceptance by the Architect and Owner. Replace defective items including doors or frames that are damaged or unacceptable to the Architect and Owner.
- B. Fire Door Assembly Inspection and Testing: Upon completion of the installation, provide functional testing and inspection of each fire door assembly on the project to confirm proper operation and that it meets all criteria of a fire door assembly as per NFPA 80, 2007/2010 edition. Inspections shall be performed by individuals with knowledge and understanding of the operating components of the door being subjected to testing and who are certified by Intertek as a Fire Door Assembly Inspector (FDAI) or a credentialed Architectural Hardware Consultant (AHC). A written report using reporting forms provided by the Door and Hardware Institute shall be maintained and transmitted to the Owner and made available to the Authority Having Jurisdiction (AHJ). The report shall list each fire door throughout the project, and include each door number, location, hardware set used and summary of deficiencies.
 - 1. Schedule fire door assembly inspection within 90 days of substantial completion of the project.
 - 2. Correct all deficiencies and schedule a re-inspection of fire door assemblies which were noted as deficient on the inspection report.
 - 3. Inspector shall re-inspect fire door assemblies after repairs are made.
 - 4. Additional re-inspections which are required due to incomplete repairs will be performed by the inspector at the expense of the Contractor.
- C. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

3.5 PROTECTION

- A. Provide for the proper protection of doors and frames until the Owner accepts the project as complete. Damaged or disfigured doors and frames shall be replaced or repaired by the responsible party.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rolling service doors.

1.2 RELATED SECTIONS

- A. Section 08 71 00 - Door Hardware: Product Requirements for cylinder core and keys.
- B. Section 09 90 00 - Painting: Field applied finish.
- C. Section 26 05 33.16 – Boxes for Electrical Systems: Conduit from electric circuit to door operator and from door operator to control station.
- D. Section 26 05 83 - Wiring Connections: Power to disconnect.

1.3 REFERENCES

- A. ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.
- B. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.
- C. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
- D. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- E. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- F. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- G. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- H. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- J. NEMA MG 1 - Motors and Generators.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Details of construction and fabrication.
 - 4. Installation instructions.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

- C. Store materials in a dry, warm, ventilated weathertight location.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.10 WARRANTY

- A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.
- B. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.
- C. PowderGuard Finish
 1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.
 2. PowderGuard Zinc Base Coat applied to guides, bottom bar, headplates plus PowderGuard Premium applied to curtain and top coat for guides, bottom bar, headplates: Manufacturer's limited Zinc Finish warranty for 4 years.
 3. PowderGuard Textured: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Textured Finish warranty for 3 years.
 4. PowderGuard Zinc Base Coat applied to guides, bottom bar, headplates plus PowderGuard Textured applied to curtain and top coat for guides, bottom bar, headplates: Manufacturer's limited Zinc Finish warranty for 4 years.
 5. PowderGuard Max: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Max Finish warranty for 5 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 ROLLING SERVICE DOORS

- A. Heavy Duty Industrial Doors: Overhead Door Corporation, Model 620 Stormtite Rolling Service Doors.
1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - a. Flat profile type F-265 for doors up to 18 feet 4 inches (5.59 m) wide, fabricated of:
 - 1) 22 gauge galvanized steel.
 - 2) 20 gauge galvanized steel.
 - 3) 18 gauge galvanized steel.
 - 4) 16 gauge galvanized steel.
 - 5) 22 gauge stainless steel.
 - 6) 20 gauge stainless steel.
 - 7) .040 inch (1 mm) aluminum.
 - b. Flat profile type F-265 for doors between 18 feet 4 inches (5.59 m) and 25 feet 4 inches (7.72 m) wide, fabricated of:
 - 1) 20 gauge galvanized steel.
 - 2) 18 gauge galvanized steel.
 - 3) 16 gauge galvanized steel.
 - 4) 20 gauge stainless steel.
 - 5) .050 inch (1.29 mm) aluminum.
 - c. Flat profile type F-265 for doors between 25 feet 4 inches (7.72 m) and 40 feet (12.19 m) wide, fabricated of:
 - 1) 18 gauge galvanized steel.
 - 2) 16 gauge galvanized steel.
 - 3) .050 inch (1.29 mm) aluminum. (Maximum width of 27 feet (8.23 m)).
 2. Slats and Hood Finish:
 - a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
 - 1) Polyester Top Coat.
 - (a) Gray polyester.
 - (b) Tan polyester.
 - (c) White polyester.
 - (d) Brown polyester.
 - 2) Powder Coat:
 - (a) PowderGuard Premium powder coat color as selected by the Architect.
 - (b) PowderGuard Textured powder coat color as selected by the Architect.
 - (c) PowderGuard Max powder coat, color as selected by Architect.
 - 3) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
 - b. Stainless Steel: Slats and hood shall be stainless steel finished as follows.
 - 1) Finish: 2B mill finish.
 - 2) Finish: No. 4 satin finish.
 - c. Aluminum: Slats and hood shall be aluminum finished as follows.
 - 1) Finish: Mill finish.
 - 2) Finish: Clear anodized finish.
 - 3) Finish: Bronze anodized finish.

- 4) Powder Coat:
 - (a) PowderGuard Premium powder coat color as selected by the Architect.
 - (b) PowderGuard Textured powder coat color as selected by the Architect.
 - (c) PowderGuard Max powder coat, color as selected by Architect.
3. Weatherseals:
 - a. Vinyl bottom seal, exterior guide and internal hood seals.
 - b. Interior guide weatherseal.
 - c. Lintel weatherseal.
4. Bottom Bar:
 - a. Extruded aluminum for doors up to 15 feet 4 inches (4.67 m) wide.
 - b. Two primed steel angles for doors over 15 feet 4 inches (4.67 m) wide.
 - c. Two galvanized steel angles.
5. Guides: Three structural steel angles.
6. Brackets:
 - a. Hot rolled prime painted steel to support counterbalance, curtain and hood.
 - b. Galvanized steel to support counterbalance, curtain and hood.
7. Finish; Bottom Bar, Guides, Headplate and Brackets:
 - a. PowderGuard Premium powder coat in black color.
 - b. PowderGuard Premium powder coat color as selected by the Architect.
 - c. PowderGuard Zinc base coat, gray.
 - d. PowderGuard Zinc base coat with PowderGuard Premium powder coat color as selected by the Architect.
 - e. PowderGuard Textured powder coat color as selected by the Architect.
 - f. PowderGuard Max powder coat color as selected by the Architect.
8. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
9. Hood: Provide with internal hood baffle weatherseal.
 - a. 24 gauge galvanized steel with intermediate supports as required.
 - b. Stainless steel, 24 gauge hood with intermediate supports as required.
 - c. Aluminum hood with intermediate supports as required.
10. Manual Operation:
 - a. Manual push up for doors up to 96 SF.
 - b. Chain hoist for doors up to 96 SF.
 - c. Chain hoist for doors over 96 SF.
 - d. Crank operation.
11. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
 - a. Sensing Edge Protection:
 - 1) Pneumatic sensing edge.
 - 2) Electric sensing edge.
 - b. Operator Controls:
 - 1) Push-button operated control stations with open, close, and stop buttons.
 - 2) Key operation with open, close, and stop controls.
 - 3) Push-button and key operated control stations with open, close, and stop buttons.
 - 4) Controls for interior location.
 - 5) Controls for exterior location.
 - 6) Controls for both interior and exterior location.
 - 7) Controls surface mounted.

- 8) Controls flush mounted.
- c. Special Operation:
 - 1) Vehicle detector operation.
 - 2) Radio control operation.
 - 3) Card reader control.
 - 4) Photocell operation.
 - 5) Door timer operation.
 - 6) Commercial light package.
 - 7) Explosion and dust ignition proof control wiring.
- d. Motor Voltage: 115/230 single phase, 60 Hz.
- 12. Wind Load Design:
 - a. Standard wind load shall be 20 PSF.
 - b. Miami-Dade County NOA ____.
 - c. FBC certification FL# ____.
 - d. TDI Approval # ____.
- 13. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
- 14. Locking:
 - a. Two interior bottom bar slide bolts for manually operated doors.
 - b. Interior bottom bar slide bolt with chain hoist operation.
 - c. Chain keeper locks for chain hoist operation.
 - d. Interior slide bolt lock for electric operation with interlock switch.
 - e. Cylinder lock for electric operation with interlock switch.
- 15. Wall Mounting Condition:
 - a. Face-of-wall mounting.
 - b. Between jambs mounting.
- 16. Vision Lites: Provide with uniformly spaced openings.
 - a. Size: 3 inch by 5/8 inch (76 mm by 16 mm).
 - b. Size: 10 inch by 1 inch (254 mm by 25.4 mm)
 - c. Provide open with no cover.
 - d. Provide with Plexiglas covers over openings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

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

- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- G. Install perimeter trim and closures.
- H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing and installing of gypsum board construction (walls and ceilings), all other accessories as shown and noted on the drawings and specified herein. The Conditions of the Contract and Division 1 apply to this section as fully as if repeated herein.

1.2 REFERENCES:

- A. The editions referenced herein of specifications and standards published by the following organizations, apply to the work only to the extent specified by the reference.

American Society of Testing and Materials (ASTM)
Gypsum Association (GA)
Technical Services Information Bureau (TSIB)

1.3 SUBMITTALS:

- A. Product Data: Submit product data for each type of product specified.
- B. Certificates: Submit manufacturer's certification that products meet or exceed requirements of the referenced specifications.
- C. Submittal procedures and quantities are specified in Section 01 33 23.

1.4 QUALITY ASSURANCE:

- A. Gypsum Board Construction: Meet the requirements of the California Code of Regulations (CCR) Title 24 Part 2, California Building Code, Chapter 25, Gypsum Board and Plaster.
- B. Fire-Resistive Construction: Meet the requirements of CCR Title 24 Part 2 Chapter 7, Fire –Resistance-Rated Construction. Provide fire-resistance rated assemblies identical to those in Chapter 7 of the CCR Title 24 Part 2 or in listing of other testing agencies acceptable to the State Fire Marshal.
- C. Fire Resistive Gypsum Board: Bear the Underwriter's Laboratories Inc. (UL) label or label of another organization acceptable to the State Fire Marshal.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver gypsum board and accessories in the manufacturer's original unopened

containers, bundles or rolls bearing the manufacturer's name and brand designation.

- B. Store materials inside the building or in other dry weathertight enclosure. Stack gypsum board flat and off the floor. Do not stack long lengths over shorter lengths.
- C. Store flammable adhesives away from fire, sparks and smoking areas.
- D. Handle gypsum board to prevent damage to edges, ends, and surfaces.

1.6 PROJECT CONDITIONS:

- A. Room temperature shall be maintained at not less than 50 degrees F for a period of 48 hours before installation until the permanent heating system is in operation. Provide ventilation during and following adhesive and joint treatment application. Use temporary air circulators in enclosed areas lacking natural ventilation.
- B. Do not apply gypsum board until insulation, pipes, conduits, ducts, vents, supports and other items that will be concealed by the gypsum board have been inspected, tested and approved by the governing authorities and unsatisfactory conditions have been corrected.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Gypsum Board: Conform to the following standards.
 - 1. Regular Gypsum Board: ASTM C 1396/C 1396 M, with tapered edges, 5/8 inch thick unless otherwise indicated.
 - 2. Fire Retardant Gypsum Board: ASTM C 1396/C 1396 M, Type X, with tapered edges, 5/8 inch thick unless otherwise indicated.
 - 3. Foil Backed Gypsum Board: ASTM C 1396/C1396 M with tapered edges, 5/8 inch thick unless otherwise indicated.
 - 4. Water Resistant Gypsum Board: ASTM C 1396/C1396 M with tapered edges, 5/8 inch thick unless otherwise indicated.
 - 5. Fire Retardant, Water Resistant Gypsum Board: ASTM C 1396/C1396 M, Type X, with tapered edges, 5/8 inch thick unless otherwise indicated.
 - 6. Fire Retardant Backing Board: ASTM C 1396/C 1396 M, Type X, with square edges, 5/8 inch thick unless otherwise indicated.
 - 7. Fire Retardant Gypsum Sheathing: ASTM C 1396/C 1396 M , Type X, with square edges, 5/8 inch thick, minimum size 4'-0" x 8'-0" as manufactured by Gold Bond, National Gypsum "Fire-Shield Jumbo Gypsum Sheathing" or equal.
- B. Wood screws for attaching gypsum board to wood stud framing and furring shall be manufacturer's standard Type "W" Bugle Head Screws.
- C. Resilient Channels: Fabricate resilient furring members in accordance with ASTM C 645, from hot dip zinc coated steel minimum 0.0179 inch thick. Provide manufacturer's

special type designed to reduce sound transmission. Acceptable products, or equal:

1. U.S. Gypsum Co.; RC-1 Resilient Channels
 2. SoundProofing Co. Inc., RC-1
- D. Metal Trim: ASTM C 1047, fabricated from hot-dip zinc coated sheet steel. Use metal corner bead for external corners and angles and unequal leg channel-type metal edge trim at junctions of gypsum board and walls of other materials.
- E. Taping and Finishing Materials: ASTM C 475, all-purpose type.
1. Joint Tape: Paper reinforcing tape.
 2. Joint Compound: Factory-packages vinyl-based, ready-mixed formulation, all-purpose type formulated for both taping and topping compounds.
- F. Wall Texture Finish Material: U.S. Gypsum Co., Texture II, Flat ripple finish in a latex emulsion capable of producing a fine "Orange Peel" finish, or equal.
- G. Acoustical Sealant: Specified in Section 07 92 00.
- H. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.
- I. Control Joints:
1. Flat Surfaces: Hot-dip zinc coated sheet steel, .093 inches thickness, "v" shaped.
 2. Curved Surfaces: Vinyl extrusion "v" joint bonded to zinc coated steel flanges. Acceptable product or equal: Gold Bond Gypsum Products; E-Z Strip.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Before applying gypsum board ensure that corners and framing are plumb, true and solid and that framing members are properly spaced. Edges and ends of board shall have solid bearing. Do not start work until deficiencies have been corrected. Start of work of this section constitutes acceptance of the surfaces.

3.2 INSTALLATION OF GYPSUM BOARD:

A. Application:

1. Unless noted otherwise, use water resistant gypsum board within toilets, kitchen, within 8' of sinks and water heaters, and elsewhere as indicated.
2. Use backing board or regular gypsum board for base layer for 2-layer applications. Use Type X gypsum sheathing or Type X gypsum board where required for fire rating.
3. Use fire retardant gypsum board where indicated or required to achieve fire rated

- partitions and ceilings.
 - 4. Use foil backed gypsum board for metal framed or furred exterior walls insulated with unfaced batt insulation.
 - 5. Use Type X or regular gypsum board in all locations not otherwise indicated or specified.
- B. General: Install and finish gypsum boards to comply with ASTM C 840 and GA-216.
- 1. Use gypsum board of maximum practicable lengths to minimize end joints. Stagger end joints when they occur. Locate end joints as far as possible from the center of walls and ceilings.
 - 2. Install gypsum boards in moderate contact, without forcing them in place. Do not place square or cut ends or cut edges against tapered edges.
 - 3. Except for face layer of double layer construction, support ends and edges of gypsum boards on framing or furring members. Joints on opposite sides of the same partition shall not occur on the same stud.
 - 4. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum board over metal framing with floating internal corner construction.
- C. Fastening: Locate fasteners not more than 1 inch from edges and not less than 3/8 inch from edges and ends of gypsum board. Drive fasteners perpendicular to the gypsum board surface with heads set slightly below the gypsum board surface for finish layers and even with the surface for base layers. Attach gypsum board starting from the center of each panel and proceeding toward the outer edges. Fasten gypsum board in place with screws over metal framing and with nails or screws over wood framing.
- D. Sound Rated Partitions: Where sound rated partitions are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Acoustical sealant specified in Section 07 92 00. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- E. Nonrated Single Layer Construction:
- 1. Apply gypsum board with the long dimension at right angles to ceiling framing and at right angles or parallel to wall framing members. Use maximum-length panels to minimize end joints.
 - 2. Apply ceiling panels before wall/partition board application to the greatest extent possible.
 - 3. Attach gypsum board with screws spaced 12 inches on center for ceilings and 16 inches on center for walls. Use 1 1/4 inch long screws for 5/8 inch thick gypsum board over metal framing and furring.
- F. Nonrated Double Layer Construction: Provide one of the following methods at the Contractor's option.

1. Mechanically Fastened Face Layer: Apply base layer with the long dimension at right angles for the framing members. Attach the base layer with screws spaced 24 inches on center. Use 1-1/4 inch long screws for metal framing. Apply face layer with long dimension at right angles to the base layer. Attach the face layer with screws 24 inches on center. Use 1-7/8 inch long screws.
 2. Adhesive Applied Face Layer: Apply base layer with the long dimension at right angles to the framing members. Attach the base layer with nails or screws of sizes and spacings as specified for single layer construction. Apply the face layer with long dimension perpendicular to the base layer. Laminate the face layer to the base layer with all purpose joint compound applied to the back of the panel with a notched spreader. Hold the face layer in position until adequate bond is achieved using temporary fasteners or bracing. Remove temporary fasteners and fill all holes with joint compound as specified herein.
- G. Rated Fire Resistive Partitions: Install and fasten gypsum board in accordance with CCR Title 24, Part 2, Table 721.1 or UL Design.
- H. Double Layer Rated Fire Resistive Gypsum Sheathing: Apply first layer of sheathing vertically over the center of framing members. Fit sheathing snugly around all openings. Attach sheathing with 1-1/4" long wallboard screws spaced 4" on center maximum around perimeter and 8" on center to intermediate studs. Apply second layer of sheathing similar to the first with joints staggered 24". Attach second layer of sheathing to the studs (through the first layer) using 1-7/8" long wallboard screws spaced a 8" on center maximum around perimeter and 12" on center maximum in the field. Cover sheathing with building paper and lath prior to application of exterior plaster.
- I. Double Layer Curved Surfaces: Thoroughly moisten the 1/4" thick gypsum wallboard using a short nap paint roller, water pump, or spray gun, applying clean water to the entire face and back surfaces. Do not allow water to stand or puddle. Stack moistened boards on a flat surface and allow to stand for at least one hour. Apply base layer at right angles to framing, fasten one end to the framing with screws at 24" on center and gradually push the board against the framing, fastening with screws at 24" on center as the work proceeds from the fixed end toward the free end. Apply the face layer at right angles to the base layer working in the same manner.
- J. Resilient Channels: Install resilient channels at right angles to the framing members. Attach channels through alternate flanges at each framing member with screws. Screws shall be 1-1/4 inch long for wood framing. Splice channels by nesting directly over framing members and attaching through each resilient channel flanges with one fastener.
- K. Metal Trim: Attach edge trim and control joints with screws spaced not more than 9 inches on center. Corner bead to be attached with either a tape-on or a crimping method for metal framing.
1. Install the gypsum board metal corner trim where indicated and at vertical and

- horizontal external corners and angles.
 - 2. Install metal edge trim where indicated and at junctions of gypsum board and walls of other materials and where there are exposed edges.
 - 3. Provide control joints where indicated on the drawings. If no control joints are indicated, provide joints to ensure that unbroken wall surfaces are limited to 30 feet in length and unbroken ceiling surfaces are limited to 2500 square feet or 50 feet in either direction.
- L. Edge Sealing: Cut edges, utility holes, and joints of water resistant gypsum board shall be treated with the gypsum board manufactures recommended waterproof sealant before installation.

3.3 TAPING AND FINISHING:

- A. Tape and finish joints, corners, fastener heads, and other imperfections in accordance with the manufacturer's specifications and recommendations to provide a smooth finish.
- B. Reinforce joints, wall and ceiling angles, and inside vertical corners with tape embedded in joint compound. Finish with not less than 2 applications of joint compound, allowing each application to dry thoroughly and sanding between coats as required.
- C. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish in accordance with GA-214.
 - 1. Level 1: Provide for ceiling plenum areas and concealed areas, unless a higher level of finish is required for fire-resistive-rated assemblies and sound-rated assemblies. Where Level 1 gypsum board finish is indicated or specified, all joints and interior angles shall have tape placed in joint compound. Tool marks and ridges are acceptable.
 - 2. Level 2: Provide for gypsum board substrates for ceramic tile or other panel application. Where Level 2 gypsum board finish is indicated or specified. All joints and interior angles shall have tape "placed" in joint compound. The joint tape shall be embedded by wiping down the joint tape and removing the excessive joint compound immediately with a knife or a trowel leaving a thin inconsistent coating of joint compound over all the joint tape (known as the "Embedment Coat"). One coat of joint compound shall be applied over all fasteners heads and accessories. Tool marks and ridges are acceptable.
 - 3. Level 3: Provide for all exposed gypsum board surfaces a medium "orange peel" textured finish as approved by the Architect. Where Level 3 gypsum board finish is indicated or specified, embed tape into joint compound (as described for Level 2) for all joints and interior angles. One additional coat of joint compound shall be applied over all joints and interior angles. Two separate coats of joint compound shall be applied over all fastener heads and accessories. All joint compounds shall be smooth and free of tool marks. After drying, lightly sand or otherwise treat the surface of the compound to provide a smooth even surface free of surface variations.

- 4. Level 4: Not Used.
- 5. Level 5: Not Used.

- D. Treat external corners, edges, and ends with metal beads and edge trim. Finish with 3 coats of joint compound and feather out between 8 inches and 10 inches from the nose.
- E. The final application of compound and sanding shall leave all gypsum board surfaces uniformly smooth and in condition to receive specified finish.
- F. Once the Level 3 is completed, the surface shall receive a coat of drywall primer before texture is applied.

3.4 REPAIR, CLEAN-UP AND PROTECTION:

- A. Repair fastener pops by driving a new fastener approximately 1-1/2 inches from the fastener pop and remove the faulty fastener. When face paper is punctured, drive a new fastener approximately 1-1/2 inches from the defective fastener. Fill damaged surfaces with compound.
- B. Upon completion of the work, remove from adjacent surfaces, overspray, splatter and daubs of taping and finish compound and textured finishes. Remove tools, equipment, unused material and cuttings and leave the work in a clean orderly manner.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section includes: Acoustical ceilings complete, including acoustical lay-in panels, acoustical tile, and suspension systems.
- B. Related Documents: The Conditions of the Contract and Division 1 apply to this section as fully as if repeated herein.

1.2 REFERENCES:

- A. The editions of standards and specifications published by the organizations, listed below and referenced herein, apply to the work only to the extent specified by the reference.

American Society for Testing and Materials (ASTM)
General Services Administration Federal Specifications (Fed. Spec.)

1.3 SUBMITTALS:

- A. Shop Drawings: Submit shop drawings showing reflected ceiling plans; location of acoustical ceilings and suspension systems; location of light fixtures, diffusers, speakers and other exposed to view items; list of materials; dimensions, jointing, method of hanger attachment, fastenings and other pertinent information. Shop drawings may be in the form of revised copies of the Architect's reflected ceiling plan showing any proposed changes from the layout indicated.
- B. Product Data:
 - 1. Submit manufacturer's catalog cuts, specifications, and other data for each component of the acoustical ceiling systems as necessary to demonstrate compliance with these specifications.
 - 2. Submit copies of the suspension system manufacturer's current ICC Evaluation Report.
- C. Samples: Submit the following samples for review:
 - 1. 12-inch long samples of main tees, cross tees and perimeter molding.
 - 2. 12" by 12" samples of each type of acoustical units to be used in the work.
- D. Submittal procedures and quantities are specified in Section 01 33 23.

1.4 REGULATORY REQUIREMENTS:

- A. Flame Spread Rating: Provide acoustical ceiling units bearing the label of Underwriters' Laboratories, or other testing agency acceptable to the State Fire Marshal, indicating that the units provide the specified flame spread rating.
- B. Seismic Requirements: Furnish and install suspension systems in accordance with the suspension system manufacturer's current ICC Evaluation Report; California Code of Regulations (CCR), Title 24 Part 2 and Interpretation of Regulations No IR 25-2.13 issued by the Division of the State Architect.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to the project in original unopened packages bearing the manufacturer's name, brand designation, and label verifying compliance with these specifications. Store materials in properly protected and dry storage area.
- B. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed.

1.6 PROJECT CONDITIONS:

- A. Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent continuously from 24 hours before installation until 24 hours after completion of work.

1.7 SCHEDULING:

- A. Wet operations such as plastering, concrete and masonry work shall be completed and dry before installation of acoustical ceilings. Mechanical, electrical and other work above the ceiling line shall be completed and approved before start of acoustical ceiling installation.

1.8 EXTRA MATERIALS:

- A. Deliver stock of maintenance material to the Owner. For each 100 acoustical ceiling units installed, furnish 2 full size acoustical ceiling units matching products installed, packaged with protective covering for storage, and identified with appropriate labels.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING UNITS:

- A. Acoustical Materials: Meet the requirements of Fed. Spec. SS-S-1188. Furnish each type specified from one manufacturer, with the color and texture identical throughout.
- B. Acoustical Lay-in Panels (Type 1):

1. Type: Noncombustible mineral fiber with a factory applied washable white finish that can be repainted repeatedly without loss of sound absorption efficiency.
2. Form: Water Felted.
3. Light Reflection Factor: 0.80 minimum.
4. Flame Spread and Smoke Developed Ratings: 0-25 flame spread and 0-50 smoke developed in accordance with ASTM E 84.
5. Noise Reduction Coefficient: Minimum 0.70.
6. Size: 24" by 48" by 5/8" thick.
7. Attenuation Factor: 35-40 dB; 11 frequency average.
8. Edge Detail: Square.
9. Pattern: Fissured.
10. Acceptable products, or approved equal:

Armstrong World Industries; Fine Fissured
 CertainTeed; Fine Fissured
 U.S.G. Interiors Inc; Fissured

C. Acoustical Tile:

1. Type: Noncombustible mineral fiber with a factory applied washable white finish that can be repainted repeatedly without loss of sound absorption efficiency.
2. Form: Wet formed mineral fiber.
3. Light Reflection Factor: 0.80 minimum.
4. Flame Spread and Smoke Developed Ratings: 0-25 flame spread and 0-50 smoke developed in accordance with ASTM E 84.
5. Noise Reduction Coefficient: Minimum 0.50.
6. Size: 12" by 12" by 5/8" thick.
7. Attenuation Factor: 35-40 dB; 11 frequency average.
8. Edge Detail: Beveled Tongue & Groove.
9. Pattern: Fissured
10. Acceptable products, or approved equal

Armstrong World Industries; Fine Fissured
 U.S.G. Interiors Inc; Radar ClimaPlus

2.2 SUSPENSION SYSTEM:

- A. Hanger Wires: Class 1 zinc coated (galvanized) carbon steel conforming to ASTM A641. Wires shall be #12 gage with soft temper and minimum tensile strength of 70 ksi.
- B. Exposed Lay-in System: Direct hung system meeting the requirements for Heavy Duty classification of ASTM C 635. Acceptable products, or approved equal:

- C. Chicago Metallic Seismic 1200 System: 200 main runners; 1274 cross tees (4'); SST Seismic separation tee for main runner splice.; 1496 Seismic perimeter clip at attached and unattached walls.
- D. Donn Corp. DX/SXL System: DX-26HRC main tees; DXL-424HRC cross tees (4'); TFS-1 for main runner splice; ACM7 seismic clip at attached and unattached walls.
- E. Armstrong World Industries, Prelude 15/16" System: 7301 main runners, XL7341HRC cross tees (4'); CS-3955 (SJMR) for main runner splice.; BERC2 clip at attached and unattached walls.
 - 1. Main Runners and Cross Tees: Double web type of cold rolled steel with protective coating and with painted steel caps. Width of exposed faces shall be 15/16 inch.
 - 2. Wall Moldings: Cold rolled steel with protective coating.
 - 3. Intersections and Connections: Provide intersections and connections capable of withstanding a mean ultimate test load of 180 pounds or twice the actual load, whichever is greater, in tension when tested in accordance with ASTM C 635.
 - 4. Finish: Finish all exposed metal parts with a baked-on vinyl finish, matte white color.

2.3 MISCELLANEOUS MATERIALS:

- A. Tile Adhesive: Meet the requirements of ASTM D 1779, type recommended by tile manufacturer, bearing UL label for flame spread rating of 25 or less.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine surfaces and conditions affecting proper installation of the materials, and report defects in materials or surfaces to which acoustical tile is applied. Do not start work until deficiencies have been corrected. Start of work of this section constitutes acceptance of the surfaces.

3.2 INSTALLATION OF CEILING SUSPENSION SYSTEMS:

- A. Suspension system installation shall comply with ASTM C636, ASTM E580 and DSA, IR 25-2.13.
- B. Place units as indicated on the shop drawings. Install with joints true and straight and junctures with ceilings, walls and openings neat and tight. Completed work shall present a smooth plane and level surface, free from unevenness, edge or corner offsets, cupping, scratches and other imperfections.
- C. Perform all cutting required for fixtures, pipes and other work passing through acoustical tile and panels. Neatly and tightly fit units to such work and adjoining work. Fit border units neatly and tightly against abutting surfaces. Replace loose and

damaged tiles and panels when directed. Touch-up all damaged finishes. Leave all surfaces clean and free from marking and other disfigurement.

D. Hanger Wires: Space hanger wires as specified. Provide each hanger wire in one piece without splices.

1. #12 gage hanger wires may be used for up to and including 4 ft. By 4 ft. Grid spacing and shall be attached to main runners.
2. Provide #12 gage hanger wires at the ends of all main and cross runners within 8 inches of the support or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area. Perimeter wires are not required when the length of the end tee is 8 inches or less.

E. Ceiling Grids:

1. Ceiling grid members shall be attached to two adjacent walls per ASTM E580. Ceiling grid members shall be at least 3/4 inch clear of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.
2. The width of the perimeter supporting closure angle shall be not less than 2 inches.
3. At the perimeter of the ceiling area, where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal spreader strut or a #16 gage wire with a positive mechanical connection to the runner may be used and placed within 8 inches of the wall. Where the perpendicular distance from the wall to the first parallel runner is 8 inches or less, this interlock is not required

F. Expansion Joints, Seismic Separation Joints, and Penetrations:

1. Lateral force bracing is required per this section for all ceiling areas. The spacing of the bracing assemblies must be shown on the construction documents.
2. For ceiling areas exceeding 2500 square feet, a seismic separation joint shall be provided to divide the ceiling into areas not exceeding 2500 square feet.

G. Lateral Force Bracing:

1. Penetrations through the ceiling for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a 2 inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of 1 inch in all horizontal directions. Alternatively, per ASTM E580, a flexible sprinkler hose fitting that can accommodate 1 inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve, or adapter.
 - a. Exception: Lateral force bracing may be omitted for suspended acoustical ceiling systems with a ceiling area of 144 square feet or less, when perimeter support, in accordance with ASTM E580, are provided and perimeter walls are designed to carry the ceiling lateral forces..

2. Provide lateral force bracing assemblies consisting of a compression strut and four #12 gage splayed bracing wires oriented 90 degrees from each other.
3. Lateral force bracing assemblies shall be spaced per Table 1 of DSA IR 25-2.13 for all values of the component importance factor (I_p) of the ceiling.
4. The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and wires shall be taut. Splices in wires are not permitted without DSA approval.
5. Compression struts shall be adequate to resist the vertical component induced by the bracing wires and shall not be more than 1 (horizontal) in 6 (vertical) out of plumb.

H. Attachment of Hanger and Bracing Wires:

1. Fasten hanger wires with not less than three (3) tight turns in 3 inches. Hanger wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops; see ASTM E580.
2. Fasten bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches.
3. Hanger or bracing wire anchored to the structure should be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.
4. Separate all ceiling hanger and bracing wires at least 6 inches from all unbraced ducts, pipes, conduit, etc.
5. Hanger wires shall not attach to or bend around interfering material or equipment. Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas.
6. Hanger wires that are more than 1 (horizontal) in 6 (vertical) out of plumb shall have counter-sloping wires. Perimeter hanger wires at main runners that are positively attached to the perimeter closure angle, counter-sloping is optional.
 - a. See ASTM C-636, Figure 1, for allowable counter-sloping methods.
7. When connection details differ from those in the attached figures, attachment of bracing wires to the structure above and to the main runners shall be adequate for the load imposed. The weight (W_p) shall be taken as not less than 4 psf for calculating seismic forces (F_p).
8. When drilled-in concrete anchors or power actuated fasteners are used in reinforced concrete for hanger wires, 1 out of 10 wire/anchor assemblies must be field tested for 200 lbs. In tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 wire/anchor assemblies must be field tested for 440 lbs. In tension in the direction of the wire. Power actuated fasteners in concrete are not permitted for bracing wires.
 - a. Drilled-in anchors or power actuated fasteners require DSA approval prior to use in prestressed concrete.

- I. Ceiling Fixtures, Terminals, and Devices: All fixtures, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with ASCE 7 and ASTM E580.
1. Ceiling panels shall not support any light fixtures, air terminals or devices.
 2. Light Fixtures:
 - a. All light fixtures shall be positively attached to the ceiling suspension systems by mechanical means to resist a horizontal force equal to the weight of the fixture. Screws or approved fasteners are required. A minimum of two attachments are required at each light fixture, per ASTM E580.
 - b. Light fixtures weighing less than or equal to 10 lb. shall have a minimum of one (1) #12 gage slack safety wire connected from the fixture to the structure above.
 - c. Light fixtures weighing greater than 56 lb. shall be independently supported by not less than four (4) taut #12 gage wires attached to the housing and to the structure above. The four (4) taut #12 gage wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.
 - d. All 4 ft. x 4 ft. Light fixtures must have slack safety wires at each corner unless supported
 - e. Surface-mounted fixtures shall be attached to the main runner with at least two positive clamping devices made of material with a minimum #14 gage. Rotational spring catches do not comply. A #12 gage suspension wire shall be attached to each clamping device to the structure above. Provide additional supports when light fixtures are 8 ft. or longer. Maximum spacing between supports shall not exceed 8 feet.
 - f. Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two times the weight of the fixture. See DSA IR 16-9 for additional requirements for pendant mounted fixtures.
 - i. If the pendant mounted light fixture is directly and independently braced below the ceiling, i.e. aircraft cables to walls, then a brace assembly is not required above the ceiling.
 - ii. If the pendant mounted light fixture is not directly and independently braced below the ceiling, then a bracing assembly is required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit horizontal force. Exception: where the weight of the fixture is less than 20 pounds, a compression post is not required.

g. Rigid conduit shall not be used for attachment of the fixtures.

3. Other Devices within the Ceiling:

- a. All lightweight miscellaneous devices, such as strobe lights, speakers, occupancy sensors, exit lights, etc., shall be attached to the ceiling grid per above section. In addition, devices weighing more than 10 lbs. shall have a slack safety wire anchored to the structure above. Devices weighing more than 20 lbs. shall be supported from the structure above.

J. Re-use of Existing Ceiling Hanger Wires and Bracing Wires:

1. The gage and spacing of the wires must comply with the current applicable codes.
2. All existing ceiling hanger wire/anchor assemblies must be tested to 200 lbs.
3. All existing bracing wire/anchor assemblies must be field tested to 440 lbs.
4. If a new wire is to be spliced to an existing wire, the following is required:
 - a. The architect or structural engineer in general responsible charge must submit to the DSA for approval a detail and specification describing how the splice is to be made.
 - b. All new wires, after being spliced to the existing wires, must be field tested per loads indicated above.
 - c. All field tests must be performed in the presence of the project inspector.

3.3 INSTALLATION OF ACOUSTICAL UNITS:

- A. Acoustical Panels: Install in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
1. Install hold-down clips in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer.
- B. Adhesive Application of Acoustical Tile: Install by cementing to substrate using amount of adhesive and procedure recommended by tile manufacturer. Install splines in joints between tiles and level to 1/8 inch in 12 feet tolerance. Maintain tight butt joints, aligned both directions. Scribe and cut tile to fit accurately at ceiling edges and penetrations.

3.4 CLEAN-UP:

- A. Replace loose and damaged tile and panels when directed. Touch-up all damaged finish. Leave all surfaces clean and free from markings and other disfigurements. Remove all debris resulting from the work of this section.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. The work includes the furnishing of all materials and equipment and the completion of all painting and paint finish on all exposed interior and exterior surfaces as required to complete the finishing of the building as shown and noted on the drawings and specified herein. The General Conditions, Supplementary General Conditions, Special Conditions and Division 1 apply to this section as fully as if repeated herein.

1.2 SUBMITTALS:

- A. Submittals shall be made in accordance with Section 01 33 23.
- B. Contractor shall prepare samples of colors and textures based upon the color selections and shall submit them in duplicate for review and approval.
- C. Contractor shall submit a list of all materials proposed for use for approval. If required by the Architect, the Contractor shall submit chemical analysis of paint material for review.
- D. Submit SCAQMD compliant products only.

1.3 GENERAL REQUIREMENTS:

- A. The Contractor shall examine the drawings and the specifications of other trades and shall consult with the other trades to determine the full extent of work and items which are specified to include shop priming and shop finish painting.
- B. All conditions affecting the work of this section shall be verified at the job site.
- C. No materials other than those specified, or approved, shall be delivered to the job or used on the work. Materials shall be delivered in manufacturer's sealed containers with labels defining the contents thereon.
- D. Paint materials and equipment, when not in actual use, shall be stored in places specifically assigned for that purpose. Such storage space shall be well ventilated and adequately fire protected. All paint mixing and handling shall be performed in these assigned areas and all containers used for mixing and handling shall be metal and suitably designed for safety. All paint materials, including rags, tarpaulins, mixers, empty containers and filled or partially filled containers shall be removed from the building areas at the close of each working day.

1.4 QUALITY ASSURANCE:

- A. Regulatory Requirements: Comply with applicable codes and regulations of governmental agencies having jurisdiction including those having jurisdiction over airborne emissions and industrial waste disposal. Where those requirements conflict with this Specification, comply with the more stringent provisions.
- B. Comply with the current applicable regulations of the
 - 1. California Air Resources Board (CARB).
 - 2. South Coast Air Quality Management District (SCAQMD)
 - 3. Environmental Protection Agency (EPA).

1.5 WORK INCLUDED:

- A. The intent and requirements of this section is that all work, items and surfaces which are normally painted in a building of this type, shall be so included in this contract, whether or not said work, item or surface is specifically called out and included in the schedules and notes on the drawings.
- B. The following general categories of work and items that are included under other sections, shall not be a part of this section:
 - 1. Shop prime painting of structural and miscellaneous iron or steel.
 - 2. Shop prime painting of hollow metal work.
 - 3. Shop finished work and items.
- C. All exposed mechanical, plumbing and electrical work, which is not factory finished, shall be painted under this section.
- D. The Room Finish Schedules indicated on the drawings, indicates the location of interior room surfaces to be painted or finished. The schedule indications are general and do not necessarily define the detail requirements. The Contractor shall include all detailed refinements and further instructions as may be given by the Architect for the required complete finishing of all spaces and rooms.

1.6 PRODUCT HANDLING:

- A. Deliver all paint to site in manufacturer's labeled and sealed containers. Labels shall give manufacturer's name, brand, type, batch number, color of paint and instruction for reducing. Thin only in accordance with printed directions of manufacturer.

1.7 ENVIRONMENTAL CONDITIONS:

- A. Do not apply exterior paint in damp, rainy weather or until the surface has dried thoroughly from the effects of such weather. Do not apply varnish or paint when temperature is below 50 degrees F. Avoid painting surfaces when exposed to hot sunlight.

1.8 PROTECTION AND CLEAN UP:

- A. Before painting, remove hardware, accessories, plates, lighting fixtures and similar items or provide protection of such items. On completion of each space, replace or unmask above items. Use only skilled mechanics for removing and connecting above items.
- B. Wherever painting and finishing work is being performed, all floors, surfaces and items shall be carefully protected from damage by the painting work. Clean drop cloths shall be provided and used wherever necessary. All supplies, materials, paints, containers, etc., shall be orderly and carefully arranged and protected. All accidental spatter, spillage, etc., shall be immediately cleaned and the damaged surfaces restored to perfect condition. All paint spots and spatter on glass porcelain fixtures, etc., shall be completely removed and the surface cleaned.
- C. At the completion of work in each space or room, all materials, supplies, debris and rubbish shall be removed and the areas left in a clean, orderly condition.

1.9 GUARANTEE:

- A. This Contractor shall, in writing, guarantee the painting work against peeling, fading, cracking, blistering, or crazing for a period of two (2) years from the time the Notice of Completion is filed.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Acceptable Manufacturers:
 - 1. Sherwin-Williams
101 W. Prospect Ave.
Cleveland, OH 44115
(216) 566-2000
 - 2. Vista Paint
2020 E. Orange Thorpe Ave., Suite 210
Fullerton, CA 92831
(714) 680-3800
 - 3. Dunn Edwards Paints
4885 E. 52nd Place
Los Angeles, CA 90058
(888) DE-PAINT
 - 4. As indicated in the Paint Schedule or approved equal.

- B. All products must be applied in accordance with the Approved manufacturer's directions.
- C. The Contractor shall secure the Color Schedule before undercoating. Unless otherwise specified, all undercoats shall be tinted slightly to approximate the color of the finish coat. Approval of color shall be obtained before proceeding with the work.
- D. Where a specific name is not given for a product or ingredient, such item shall be of the best quality of the approved manufacturer, which is normally used for the intended purpose.

2.2 PAINTING SCHEDULE:

- A. Surfaces shall be finished in accordance with the following procedure for the surface and finish desired thereon for the following headings:

- B. Exterior:

Cast-in-place Concrete and Smooth finish plater (Stucco) where designated

Pretreatment	As recommended by manufacturer.
1 st Coat	Primer recommended by manufacturer.
2 nd Coat	Color(s) as selected by Architect.

Metal Ferrous - Flat Finish

1st Coat	Rust inhibitive primer
2nd Coat	Intermediate metal undercoat
3rd Coat	100% acrylic flat

Metal - Galvanized - Enamel Finish –Typical unless noted otherwise.

1st Coat	Corrosion inhibitive primer
2nd &	
3rd Coats	100% acrylic semi - gloss non-blocking enamel

Metal – Galvanized – Handrails

Pretreatment	Wire brushed and cleaned per manufacturer's specifications.
1st Coat	Epoxy primer (two component)
2nd &	
3rd Coats	Polyurethane base enamel (two component)

Metal - Galvanized - Flat Finish (Roof Flashings and where noted)

Pretreatment	Vinyl wash primer (etching solution)
1st Coat	Corrosion inhibitive primer
2nd Coat	Acrylic co-polymer
3rd Coat	Acrylic co-polymer

- C. INTERIORS:

Concrete Masonry - Eggshell Finish –Typical unless noted otherwise.

1st Coat	Masonry primer
2nd Coat or	
3rd Coat	Acrylic co-polymer

Gypsum Wallboard - Flat Finish

1st Coat	Pigmented Sealer (PVA emulsion type)
2nd Coat &	
3rd Coat	Acrylic-vinyl latex wall paint

Wood or Masonite - Flat Finish

1st Coat	Interior undercoat
2nd Coat &	
3rd Coat	Acrylic-vinyl wall paint

Gypsum Wallboard - Eggshell Finish–Typical unless noted otherwise

1st Coat	Pigmented Sealer (PVA emulsion type)
2nd Coat &	
3rd Coat	Acrylic eggshell enamel

Wood or Masonite - Eggshell Finish –Typical unless noted otherwise.

1st Coat	Interior pigmented wood primer
2nd Coat or	
3rd Coat	Acrylic eggshell enamel

Metal - Eggshell Finish

1st Coat	Rust inhibitive primer (Ferrous)
1st Coat	Galvanized metal primer (Galvanized)
2nd Coat	Intermediate metal undercoat
3rd Coat	Acrylic eggshell enamel

Gypsum Wallboard - Semi-gloss Finish

1st Coat	Pigmented Sealer (PVA emulsion type)
2nd Coat	Undercoater
3rd Coat	100% acrylic non-yellowing semi-gloss enamel.

Gypsum Wallboard – Epoxy - Designated Areas

1st Coat	Pigmented Sealer (manufacturer’s recommendation)
2nd Coat and	
3rd Coat	2 part epoxy gloss.

Wood - Semi-gloss Finish

1st Coat	Interior undercoat
2nd & 3rd Coat	Semi-gloss enamel Acrylic/Non-Blocking

Metal - Semi-gloss Finish

1st Coat	Rust inhibitive primer (Ferrous)
1st Coat	Galvanized metal primer (Galvanized)
2nd Coat	Intermediate metal undercoat
3rd Coat	Semi-gloss enamel Acrylic-Non Blocking

Miscellaneous: Construction visible through screen vents and grilles shall have one heavy coat of flat black paint.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. All surfaces shall be clean and dry prior to painting and finishing. Dirt and dust shall be removed by stiff bristle brush and wiping with cloths. Oil and grease shall be removed by solvent cleaning, using a solvent such as mineral spirits and wiping with clean cloths. Surfaces shall be given a final rinse of clean solvent. Surfaces which have been contaminated with chemicals shall be thoroughly rinsed with water. The first coat of paint shall be applied as soon as possible after cleaning and drying the surfaces.
- B. Surface Preparation Methods:
 1. Aluminum: Remove all oil, grease, dirt and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.
 2. Concrete Block: Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Concrete and mortar must be cured at least 30 days at 75°F, unless the manufactures products are designed for application prior to the 30 day period. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement patching compound.
 3. Concrete: Perpare in accordance with SSPC-SP13. Acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.
 4. Cement Composition Siding/Panels: Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Existing peeled or checked paint should be scraped and sanded to a sound surface. Pressure clean, if needed, to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments.

5. Copper and Stainless Steel: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP2, Hand Tool Cleaning.
6. Exterior Composition Board (Hardboard): Remove any waxy material with a solvent prior to coating. Whether factory primed or unprimed, exterior composition board siding (hardboard) must be cleaned thoroughly and primed with an alkyd primer.
7. Galvanized Metal: Clean per SSPC-SP1 using detergent and water or a degreasing cleaner to remove greases and oils. Apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 is necessary to remove these treatments.
8. Steel: Structural, Plate, etc.: Shall be cleaned by one or more of the surface preparations described below:
 - a. Solvent Cleaning, SSPC-SP1.
 - b. Hand Tool Cleaning, SSPC-SP2.
 - c. Power Tool Cleaning, SSPC-SP3.
 - d. White Metal Blast Cleaning, SSPC-SP5
 - e. Commercial Blast Cleaning, SSPC-SP6
 - f. Brush-Off Blast Cleaning, SSPC-SP7
 - g. Power Tool Cleaning to Bare Metal, SSPC-SP11
 - h. Near-White Blast Cleaning, SSPC-SP10
9. Conventional Plaster Stucco: Must be clean and free of any loose stucco. If recommended procedures for applying stucco are followed, and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments.
10. Wood—Exterior: Must be clean and dry. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.
11. Vinyl Siding, Architectural Plastics, and Fiberglass: Clean vinyl siding thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly. Do not paint with any color darker than the original siding.

3.2 APPLICATION:

- A. All materials shall be applied and cut in neatly so as to dry uniformly to the color and sheen required and shall be free from excessive runs, sags, wrinkles, shiners, streaks and brush marks.
- B. All materials shall be applied in accordance with the approved manufacturer's directions and specifications. Any thinning required, shall be done in the manner and the type of reducer recommended.

- C. Each coat of painted work shall vary in shade from the preceding coat in a manner that will make each coat readily distinguishable without affecting the finish color. The Architect will inspect each coat and operation before succeeding coats are applied to determine that the work meets the requirements of the specifications.
- D. In enclosed spaces, the application and drying of paint shall be performed only when the temperature is 65 degrees F. or above and maintained constantly to prevent condensation.
- E. Exterior painting shall only be performed when the weather conditions, temperatures and humidity are correct.
- F. Workmanship shall be of the very best quality and only skilled mechanics shall be used on this project.
- G. The work of this section shall be subject to the approval of the Architect. Any work in need of correction because of improper preparation or workmanship, or as a result of failure to comply with these Specifications, shall be satisfactorily corrected by this Contractor at his own expense.
- H. Commencement of the painting work by this Contractor shall signify his acceptance of all surfaces as satisfactory to receive the finish specified herein.
- I. This Contractor shall be responsible for the complete painting finishing of all surfaces indicated in the Room Finish Schedule and as specified herein. Where questions occur as to the indicated surfaces, he shall inform the Architect and receive clarification therefrom.
- J. The proper number of coats of paints and other finishes specified, properly applied, will result in the desired effect. Should this effect not be attained, additional applications of the specified materials and methods shall be made by the Contractor, without additional costs to the Owner.

3.3 PROTECTION:

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged coatings following manufacturer's recommendation for touch-up or repair of damaged coating. Repair any defects that will hinder the performance of the coatings.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. Related Documents: Provisions established within the General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.
- B. Section Includes:
 - 1. Unframed signs, with photopolymer face bonded to acrylic backing plaque, for interior and exterior applications.

1.2 QUALITY ASSURANCE:

- A. Supplier: Obtain all products in this section from a single supplier.
- B. Regulatory Requirements:
 - 1. Except as specified or indicated otherwise, sign work shall conform to the Accessibility Standards of the California Code of Regulations (CCR), Title 24.
 - 2. The international symbol of accessibility shall be used to identify facilities that are accessible to and usable by physically disabled persons and shall be located where shown on plans or required by the above regulations.
 - 3. Signage and graphics: Raised characters shall comply with CBC Section 11B-703.2:
 - a. Depth: It shall be 1/32-inch (0.8 mm) minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
 - b. Height: It shall be 5/8-inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter "I". CBC Section 11b-703.2.5.
 - c. Finish and contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1.
 - d. Proportions: It shall be selected from fonts where the width of the uppercase letter "O" is 60% minimum and 110% maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character. CBC Sections 11B-703.2.4 and 11B-

703.2.6.

- e. Character Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.2.7.
- f. Line Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.2.8.
- g. Format: Text shall be in a horizontal format. CBC Section 11B-703.2.9.
- h. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed or rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
- i. Mounting height: Tactile characters on signs shall be located 48" minimum to the baseline of the lowest Braille cells and 60" maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. CBC Section and Figure 11B-703.4.1.
- j. Mounting location: A tactile sign shall be located per CBC Section and Figure 11b-703.4.2 as follows:
 - i. Alongside a single door at the latch side.
 - ii. On the inactive leaf at double doors with one active leaf.
 - iii. To the right of the right-hand door at double doors with two active leaves.
 - iv. On the nearest adjacent wall where there is no wall space at the latch side of a single door or at the right side of double doors with two active leaves.
 - v. So that a clear floor space of 18" x 18" minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45-degree open position.
- k. Visual Characters shall comply with CBC Section 11B-703.5 and shall be 40" minimum above finish floor or ground. Visual character stroke thickness of the uppercase letter "I" shall be 10% minimum and 20% maximum of the height of the character. CNC Section 11B-703.5.7.
 - i. Line Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.5.9.
 - ii. Character Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.5.8.
- l. Pictograms shall comply with CBC Section 11B-703.6.
- m. Symbols of accessibility shall comply with CBC Section 11B-703.7.
- n. Variable message signs shall comply with CBC Section 11B-703.8.

- C. Installer: Installation shall be performed by installer specialized and experienced in work similar to that required for this project.

1.3 SUBMITTALS:

- A. Submit in accordance with requirements of Division 1 and Section 01 33 23.
- B. Product Data: Submit product data for specified products. Include material details for each sign specified.
- C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.
- D. Samples: Submit supplier's standard color chart for selection purposes and selected colors for verification purposes.
- E. Installation: Submit supplier's installation instructions.
- F. Closeout Submittals:
 - 1. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
 - 2. Submit warranty documents specified herein.

1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Comply with requirements of Division 1.
 - 1. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
 - 2. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 3. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
 - 4. Handle products in accordance with manufacturer's instructions.

1.5 WARRANTY:

- A. Project Warranty: Comply with requirements of Division 1.
- B. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
 - 1. Warranty Period: one (1) year from product ship date.

PART 2 - PRODUCTS

2.1 SIGNAGE SYSTEMS:

A. Acceptable Manufacturers:

1. ASI Signage Innovation, 8181 Jetstar Drive, Suite 100, Irving, Texas 75063; (214) 352- 9140 telephone; (214) 352-9741 facsimile; (800) ASI-SPEC [274- 7732]
2. Substitutions: Submit in accordance with Division 1.

B. Acceptable Product: InTouch™ ADA- Ready™ Sign System with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes, and details.

2.2 SIGN MATERIALS:

A. Face: Intouch Photopolymer Face, in matte (non-glare) finish.

B. Backing Plate: Acrylic.

2.3 FABRICATION OPTIONS:

A. Tactile Graphics and Text:

1. Fabrication process: Provide tactile copy [and grade 2 Braille] raised 1/32 inch minimum from plaque first surface by manufacturer's photopolymer bonded process. Sign face of single material, tactile characters, and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
2. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors. Tactile characters to be raised min. 1/32" from surface. Computerized translation of sign copy to be responsibility of the manufacturer.

B. Mounting Panel:

1. Size: As detailed per plans.
2. Thickness: 0.25-inch-thick matte finished acrylic.

C. Background Appearance:

1. Solid color[s]: Select from manufacturer's standard range.

D. Tactile Lettering and Graphics Color: Select from manufacturer's standard colors.

E. Overall panel size: As detailed per plans.

F. Shape: As detailed per plans.

G. Letter style[s], color[s], letter size[s] and layout position: As detailed per plans.

H. Text schedule: As detailed per plans.

2.4 INSTALLATION METHOD:

A. As detailed per plans.

2.5 FABRICATION - GENERAL

A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.
- B. Scheduling of installation by Owner or its representative implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer's acceptance of substrate and conditions.
- C. Examine substrates to receive adhesively applied identification devices before start of work to ensure that they are free of grease, oil, paint, wax, dust, dirt, or other foreign matter that might inhibit bonding to the substrate.
- D. Do not start work until deficiencies have been corrected. Start of work of this section constitutes acceptance of the surfaces.

3.2 INSTALLATION:

- A. Install product in accordance with supplier's instructions.
- B. Install product in locations indicated using mounting methods recommended by sign manufacturer and free from distortion, warp, or defect adversely affecting appearance.
- C. Install product level, plumb, and at heights indicated.
- D. Install product at heights to conform to the Accessibility Standards of the California Code of Regulations (CCR), Title 24.
- E. Install signs within the following tolerances and in accordance with manufacturer's recommendations:
 - 1. Interior Signs: Within 1/4 inch vertically and horizontally of intended location.
- F. Install signs at locations indicated. Ensure that signs are installed plumb and true, at mounting heights indicated, and by method specified. Do not install signs on doors or other surfaces until finishes on such surfaces have been applied.

- G. Anchorage: Provide anchorage where necessary for fastening signs securely in place. Anchorage not otherwise specified or indicated shall include expansion shields and powder-driven fasteners, when approved, for concrete and masonry; toggle or molly bolts to stud flanges or steel backing plates in light gage metal framed partitions; full threaded wood screws to wood doors and machine screws to metal doors.

3.3 CLEANING, PROTECTION, AND REPAIR:

- A. Repair scratches and other damage which might have occurred during installation. Replace signs which cannot be repaired to new condition. Clean sign surfaces.
- B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project in accordance with provisions in Division 1.

3.4 SIGN SCHEDULE

- A. Schedule: Refer to signage schedule and Drawings for sizes, locations, and layout of signage types, sign text copy, and graphics.

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES:

- A. Foodservice equipment.

1.2 SCOPE OF WORK:

- A. Furnish all labor, materials and services necessary for the procurement and installation of the equipment included in this section.
- B. Supervise and provide required instructions for work to be performed by other contractors in connection with requirements for all equipment included this section.
- C. Specifications and drawings have been prepared to form the basis for coordination with the other trades on this Project, procurement, erection, start-up, and adjustment of all equipment in this section. Plans and specifications are to be considered as mutually explanatory and work required by one, but not by the other, is to be performed as though required by both. Items required by one, but not by the other are to be provided as though required by both. Work to be accomplished as called for in specifications and shown on drawings, so that all items of equipment are completely functional for purpose for which they were designed. When/if there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Consultant prior to bidding.
- D. Should the drawings disagree between themselves or the specifications with the drawings, the better quality more stringent, and/or greater quantity of the work or materials to be completed without additional costs to the Owner.
- E. Secure and pay fees for all permits and licenses as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations, and contract requirements bearing on the work.

1.3 RELATED DIVISIONS / SECTIONS:

- A. Refer to General Conditions, Supplementary Conditions, and applicable provisions of Division 1 for additional instructions.
- B. Refer to Interior Design Divisions for applicable provisions and sections regarding décor finishes, applications, details, and special instructions relating to items specified in this Section. Applicable to Projects with items specified in this Section, with décor finishes and/or construction.
- C. Refer to Mechanical/Plumbing Divisions for applicable provisions and sections regarding mechanical services, including, but not limited to exhaust ductwork and fans, floor sinks and floor drains, water gas and steam rough-ins, grease traps, steam traps, drain traps, atmospheric vents, valves, pipes and pipe fittings, ductwork, and

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other materials necessary to complete final connections to individual items as specified in this Section. Not work of this Section. Also includes:

1. Piping and insulation for fryer oil systems.
 2. Piping for remote pulping systems.
 3. All exhaust hood or ventilator duct work and fans upstream from the connection position.
- D. Refer to Electrical Divisions for applicable provisions and sections regarding electrical services, including, but not limited to, rough-ins, standard voltage and low-voltage wiring, conduit, drop-cords, ceiling-mounted cord reel assemblies, disconnects and other materials necessary to complete final connections to individual items as specified in this Section. Not work of this Section. Also includes:
1. Installation of light fixtures furnished loose at cold storage rooms.
 2. Connection of cold storage room temperature alarm system to the building security system.
 3. Connection of hood fire suppression system to the building security system.
- E. Work included in other Divisions - Provision of all walls, floor, and/or ceiling/roof openings, and sealing thereof, as necessary for installation of items included in this section. Not work of this Section. Also includes:
1. Slab depressions reinforced concrete wearing bed and interior finished floor with coved base at prefabricated cold storage assemblies.
 2. Concrete or masonry platforms with finished top and coved base at perimeter, for raised setting of foodservice equipment: Divisions 03/09.
 3. Slab depressions to receive stainless-steel drain trench liner/grate assemblies provided under this Section.
 4. Wall backing to support all wall-mounted equipment.
 5. Conduit and piping sleeves for soda, beer/liquor, refrigeration, CO₂ and drain lines through building ceilings and floors.
- F. Work included in other Divisions - Disconnection of existing equipment to be relocated and/or reused; and removal of existing equipment which will not be reused, as determined and designated by the Architect in other Divisions. Not work of this Section. (*Applicable to Projects with existing equipment.*)

1.4 DEFINITIONS:

- A. Furnish - Supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. Install (set in place) - Operations at Project Site including actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, finishing, curing, protecting, cleaning and similar operations, ready for final utility connections by other Divisions as appropriate.
- C. Provide - Furnish and install complete, ready for intended use, including any necessary initial training.

- D. Contractor - Refers to the Kitchen Equipment (Sub) Contractor in this Section. References to any other Contractor or Division will be specific, such as General Contractor, Plumbing (Sub) Contractor / Division, Electrical (Sub) Contractor / Division, Architect designated, etc.

1.5 LAWS, ORDINANCES, REGULATIONS AND STANDARDS:

- A. Comply with the following in their current published form:
1. Air Conditioning and Refrigeration Institute (A.R.I): applicable regulations and references of the latest edition of standards for remote refrigeration system(s), components and installation.
 2. American Gas Association (A.G.A.): standards for gas heated equipment and provide equipment with the A.G.A. seal. Automatic safety pilots to be provided on all equipment, where available. (Canadian Gas Association or alternate testing lab's seals accepted if acceptable to local code jurisdictions.)
 3. American National Standards Institute (A.N.S.I.): Z21-Series for gas-burning equipment. Provide labels indicating name of testing agency.
 4. American National Standards Institute (A.N.S.I.): B57.1 for compressed gas cylinder connections, and with applicable standards of the Compressed Gas Association for compressed gas piping.
 5. American National Standards Institute (A.N.S.I.): A40.4 and A40.6 for water connection air gaps and vacuum breakers.
 6. American Society of Heating, Refrigeration and Air Conditioning Engineers (A.S.H.R.A.E.): applicable regulations and references of the latest edition of standards for exhaust system planning including A.S.H.R.A.E. 90.1 Section 5,6,7, and remote refrigeration system(s), components, and installation.
 7. American Society of Mechanical Engineers (A.S.M.E.): Boiler Code requirements for steam generating and steam heated equipment and provide A.S.M.E. inspection stamp and registration with National Board.
 8. American Society for Testing and Materials (A.S.T.M.): C1036 for flat glass.
 9. American Society for Testing and Materials (A.S.T.M.): C1048 for heat-treated flat glass - Kind HS, Kind FT coated and uncoated glass.
 10. American Society for Testing and Materials (A.S.T.M.): F232-03 for pre-rinse spray units, and in compliance with Energy Policy Act of 2005 (EPAAct).
 11. American Welding Society (A.W.S.): D1.1 structural welding code.
 12. Energy Policy Act of 2005 (EPAAct 2005): water savings pre-rinse spray valves.
 13. National Electric Code (N.E.C.): N.F.P.A. Volume 5 for electrical wiring and devices included with foodservice equipment, A.N.S.I. C2 and C73, and applicable N.E.M.A. and N.E.C.A. standards.
 14. National Electrical Manufacturers Association (N.E.M.A.): LD3 for high-pressure decorative laminates.
 15. National Fire Protection Association (N.F.P.A.): applicable sections for exhaust hoods, ventilators, duct and fan materials, hoods fire suppression systems, wheel placement systems, construction and installation; in addition to local codes and standards.

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16. National Sanitation Foundation (NSF): latest Standards and Revisions, and as accredited by ANSI, IAS, NELAC, ISO, OSHA and SCC. Provide NSF Seal of Approval on all standard manufactured items included in this Project and listed in any NSF Certified Food Equipment Products Category, and on all items of custom fabricated work included in this Project. (UL Sanitation approval and seal accepted if acceptable to local code jurisdictions.)
 17. Sheet Metal and Air Conditioning Contractor's National Association (S.M.A.C.N.A.): latest edition of guidelines for seismic restraint of kitchen equipment, as applicable to project location. All seismic requirements shall be shown on all submittals. Submit requested information to the agencies and authorities having jurisdiction.
 18. Underwriters Laboratories (U.L.): as applicable for electrical components and assemblies. Provide either U.L. labeled products or, where no labeling service is available, "recognized markings" to indicate listing in the U.L. "Recognized Component Index". (Canadian Standards Association or alternate testing lab's seals accepted if acceptable to local code jurisdictions.)
 19. UL 300 Standard: for wet chemical fire suppression systems for exhaust hoods/ventilators.
 20. American with Disabilities Act (ADA): as applicable to this Project.
 21. Refrigeration Service Engineers Society (R.S.E.S.): applicable regulations and references of the latest edition of standards for remote refrigeration system(s), components and installation.
 22. All refrigerants used for any purpose is to comply with the 1995 and 2010 requirements of the Montreal Protocol Agreement, and subsequent revisions and amendments. No CFC or HCFC refrigerants will be permitted on this Project.
 23. All refrigeration components installation, repairs, and/or associated work on any refrigeration system, is to be performed by a Certified Refrigeration Mechanic thoroughly familiar with this type of commercial foodservice installation. ETL and other national and international recognized Testing and Listing Agency labels and certifications are acceptable in lieu of Listing Agencies indicated in these documents, if acceptable to the local code jurisdictions.
 24. All applicable local codes, standards, and regulations.
 25. All special local codes, standard, and regulations such as (examples only) California Energy Commissions Regulations, Dade County requirements for walk-in cooler(s) and/or freezer(s).
 26. For detention facilities projects (as applicable): applicable Correctional Standards. Verify the level of security and construction required with the Architect and provide all items in compliance.
- B. The Contract Documents shall prevail whenever they require larger sizes or higher standards than are required by regulations.
- C. The above regulations shall govern whenever the Contract Documents require something that is deemed to violate the above regulations.

- D. No extra charge will be paid by Owner for furnishing items required by the regulations, but not specified and/or shown on the drawings.
- E. Rulings and interpretations of the enforcing agencies shall be considered part of the regulations.

1.6 CONTRACTOR'S QUALIFICATIONS:

- A. In addition to requirements of Related Sections 1.3.A:
 - 1. Five (5) years minimum continuous operation under the same company name and ownership.
 - 2. Financial stability and ability to complete this Project.
 - 3. Comparable size and scope projects completed in the last five (5) years.
 - 4. Contractor to provide letter that states they are able to purchase, distribute, and install all items specified.
- B. Any sub-contractor or fabricator employed by Contractor:
 - 1. Is to comply with the same qualifications.
 - 2. Their name, address, and a brief-summary of their experience and qualifications is to be submitted with the bid proposal.
 - 3. Fabrication sub-contractor shall be NSF, NEC, and UL-approved at a minimum for fabrication of all items detailed within this specification and attending drawing set. Moreover, fabrication shop shall have the means and expertise to fully engineer and fabricate any-and-all counters, tables, natural and man-made stone counter tops, food shields, etc. all in one manufacturing facility where specified as part of this document set.
 - 4. Approved fabricators include the following:
 - a. Duray
 - b. John Boos

1.7 BIDDING AND SUBSTITUTIONS:

- A. The Bidder shall provide pricing on primary manufacturer and model specified. These Contract Documents were designed and engineered using the primary manufacturer and model and are intended to be the Basis of Bid. Provide itemized prices for each item, along with cited accessories with separate total prices for delivery and installation. Any-and-all city, state, occupational and government taxes which are applicable to this project, shall be included and added as a separate charge. All figures shall be included in a grand total package bid proposal. Bids shall be valid for thirty (30) days after bid deadline date and shall indicate same. Failure to comply with the above may be cause for rejection of the bid.
- B. Unless otherwise noted, substitutions may be submitted for consideration, but must be itemized at the end of the bid proposal.

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- C. Substitutions must be approved in writing by the Architect and/or Owner, prior to utilization in this Contract. A copy of the approval must be included with any submittals by Contractor.
- D. Contractor shall provide all design/engineering services required to make-adjustments in space, systems, utilities, etc. and pay all additional costs of utilities, construction or professional services that may be incurred due to the acceptance of any substitution.
- E. Application for Substitution of Specified Foodservice Equipment. This form shall be submitted in support of each suggestion of request to substitute an alternate manufacturer and/or model of equipment that is not included in the Division 11 40 00 (Foodservice Equipment) specifications.

APPLICATION FOR SUBSTITUTION OF SPECIFIED FOODSERVICE EQUIPMENT

The decision to accept an unnamed alternate will be based exclusively on the information provided hereon and the Owner's or their designee's research and verifications of claims, which shall include sharing the information with manufacturer(s) of the originally specified equipment. Accordingly, any proprietary information regarding the proposed substitution should be so identified and submitted as an addendum to this form.

By submitting this application, the Contractor guarantees the information is correct and accepts total responsibility for all additional costs that may directly or indirectly result from acceptance of the proposed substitution. It is the interest of the Contractor to declare in this form all benefits that they may accrue to the Owner. Include the proposed manufacturer's data sheets, drawings and any other supporting information.

The original specifications describe the minimum standards of the equipment – proposed substitutions that do not meet or exceed this minimum standard or otherwise benefit the Owner will not be considered except in the case of an originally specified item that is no longer available. The Owner or their designee will be the sole authority regarding identifying specific features, capacities, etc. that are operationally critical. Acceptance of a proposed substitution does not relieve the Contractor of responsibility for all direct or indirect costs associated with the substitution.

1. Date Submitted: _____
2. Item Number:_____ Description:_____ Quantity:_____
3. Specified Manufacturer:_____ Specified Model Number:_____
4. Proposed Manufacturer:_____ Proposed Model Number:_____
5. Does the proposed equipment incorporate all features and options expressed or implied by the specifications, including features and option that are provided as standard by the specified item?
☐ Yes ☐ No – describe (attach additional sheets as required):_____

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6. Compare Utilities (attach additional sheets as required):

Specified: HW _____ CW _____ Gas (BTU) _____ Steam (BHP) _____ Electrical _____

Exhaust (cfm) _____ Duct size _____ Supply (cfm) _____ Duct size _____

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Proposed: HW _____ CW _____ Gas (BTU) _____ Steam (BHP) _____ Electrical _____

Exhaust (cfm) _____ Duct Size _____ Supply (cfm) _____ Duct Size _____

7. Compare Dimension:

Specified: Left to Right _____ Front to Rear _____ Height _____

Proposed: Left to Right _____ Front to Rear _____ Height _____

8. Does the proposed substitution require changes to the work to be provided by other trades?

☐ No ☐ Yes – describe (attach additional sheets as required): _____

9. Does the proposed substitution require changes or create any issues regarding adjacent or associated equipment (for instance: door swing interference; service access; air circulation)?

☐ No ☐ Yes – describe (attach additional sheets as required): _____

What benefits will the Owner realize as a result-of this substitution (for instance: capital expense; energy savings, flexibility)? Provide specific information.

☐ There are no benefits to the Owner.

☐ The following will benefit the Owner – (attach additional sheets as required): _____

10. Are there any other considerations that should be evaluated? _____

11. Signature of Contractor's Representative:

1.8 APPROVED SUBSTITUTIONS AND/OR LISTED ALTERNATES:

- A. Substitutions approved as noted in Article 1.7, and/or any Listed Alternate manufacturers included in the Itemized Specifications Article 3.12, or added by Addendum, may be utilized, in lieu of the primary specified manufacturer with the following conditions:
1. These Contract Documents are designed and engineered using the primary specified manufacturer and model and are intended to be the Basis of Design and Bid. Contractor assumes complete responsibility for any deviations required due to utilization of a substitution/alternate manufacturer or model; including, but not limited to, fitting alternates into available space, providing directions for required changes, and assuming any associated cost for utility, building, architectural, or engineering changes.
 2. Contractor is responsible for supplying the model, which is as close as possible to the primary specified model in regard to general function, features, options, sizes, accessories, utility requirements, finish, operation, internal system engineering and listing approvals. If it is determined by the owner or their appointed representative at any time during the construction and installation process, and prior to the final acceptance of the Project, that the substitution/alternate model submitted is not equivalent to the primary specified model, the Contractor will assume all associated cost and implications required to replace the model submitted, with the correct model.
 3. The bid proposal is to clearly state any proposed substitutions/alternates, that are being offered for review by including the manufacturer and model number. Along with a current data sheet for each substitution/alternate, with any-and-all deviations between the primary specified manufacturer and the substitution/alternate manufacturer clearly defined. Technical brochures from manufacturers may not be acceptable as adequate information required for comparison. Complex alternates such as utility distribution systems, exhaust hoods, ventilators, refrigeration systems, etc., shall include a shop drawing specific to this Project.
 4. Inclusion of an alternate manufacturer in Itemized Specifications Article 3.12 is not intended to indicate that there is an equal alternate unit to match every primary specified unit. It is the responsibility of the Contractor to ensure that the alternate unit submitted matches or exceeds the primary specified unit; and meets the conditions as stated above.
 5. Manufacturers not approved as substitutions or included as a Listed Alternates will not be permitted.

1.9 DISCREPANCIES:

- A. Where discrepancies are discovered between the drawings and the specifications, regarding quality or quantity, the higher quality or the greater quantity is to be included in the Bid Proposal.
- B. Contractor to notify the Architect, in writing, of any discrepancies discovered; and await written clarification prior to proceeding with the items or areas in question.

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- C. Contractor is responsible for verifying and coordinating all items provided in this Section, with the drawings, specifications, manufacturer's requirements, submittals, actual site conditions, adjacent items, and associated (Sub-) Contractors; to assure that there are no discrepancies or conflicts. This is to include, but not be limited to, quantities, dimensions, clearances required, direction of operation, door swings, utilities, fabrication details and methods, installation requirements, etc.

1.10 SUBMITTALS:

- A. Provide one (1) digital set (PDF) of all Submittals for review by the Design Team. After review process this set will be returned for any updating necessary and subsequent distribution.
- B. Substitutions must be approved in writing by the Architect and/or Owner prior to utilization in this contract. A copy of the approval must be included with any submittals.
- C. Contractor to review all submittals for compliance with the Contract Documents, prior to submitting to the Design Team for review and is responsible for the accuracy of the information within their submittals.
- D. Contractor's use of any Design Team's digital contract drawings for basis of producing their submittal drawings, is limited to the following conditions, and understanding:
1. Contractor shall perform a thorough project review of all foodservice and allied discipline (MEPS) documents within the Contract Document set and provide independent engineering for all equipment to be provided. Contractor shall assume complete liability and responsibility for accuracy, and for conformance and verification with the latest Architectural and Engineering drawings, actual field conditions and equipment to be provided as part of contract.
 2. The copy and simple re-use of the foodservice consultant's equipment plans, connection plans, building conditions plans, manufacturer's drawings, elevations/sections are prohibited.
 3. Contractor further assumes responsibility for coordination of their submittals with those of other allied Contractors and Sub-Contractors, such as electrical, plumbing, and mechanical contractors as required.
 4. Submittals shall contain Contractor's notes, symbols, details, title block and information.
- E. Equipment Plan and Rough-In Drawings:
1. Submit 1/4" (1:50) scale drawings in pdf format. These drawings are to include complete information on the work included in this Contract, with references to equipment as provided by others; and are to provide sufficient information for associated trades, contractors, and/or sub-contractors to complete their division of work associated with foodservice equipment

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included in this Contract. Include any additional information pertinent to the installation of this equipment.

2. Special Conditions Drawings, dimensioned, sizing and locating the following conditions:
 - a. Slab depressions, cores, sleeves, or block-outs (cold storage assemblies drain trenches, piping, etc.).
 - b. Concrete or masonry platforms.
 - c. Pipe sleeves or roof jacks.
 - d. Wall-openings or block-outs for pass-through equipment, recessed control panels, in-wall fire-protection system components, etc.
 - e. Blocking grounds or anchor plates required in walls for equipment support/attachment.
 - f. Above-ceiling hanger assemblies for support of exhaust hoods, utensil-racks, etc.
 - g. Access panels in walls or ceiling for service of equipment.
 - h. Ceiling pockets or recesses for unusually high equipment.
 - i. In-wall carriers for wall-hung or cantilevered equipment.
 - j. Ventilation for exhaust hoods, condensate hoods, ice machines, compressors, compressor racks and all other equipment requiring heat removal.
 - k. Support systems such as beverage conduit and refrigeration line-run sleeves.
 - l. Any other additional information pertinent to the installation of this equipment.
3. Electrical Rough-in Drawings field-coordinated and dimensioned providing the following information, but not limited to:
 - a. Electrical utility schedule.
 - b. Locations of rough-ins.
 - c. Locations of control panels.
 - d. Inter-wiring of walk-in freezer compressors to compressor rack control panel for defrost cycle.
 - e. Inter-wiring of controls panels to equipment.
4. Plumbing Rough-In Drawings field-coordinated and dimensioned providing the following information, but not limited to:
 - a. Plumbing utility schedule.
 - b. Locations of rough-ins.
 - c. Interconnection water filters assemblies to ice machine, beverage equipment, combi-ovens, steamers, etc.
5. Field-coordinated, dimensioned refrigeration line-run drawings providing the following information, but not limited to:
 - a. Sleeve locations & sizes for walls, floors, ceilings.
 - b. Detailed and field-coordinated route of refrigeration line-runs from remote refrigeration system to unit served.
 - c. Location and inter-wiring detail required for any temperature monitoring and/or control system specified.
6. Drawings to also include equipment plan(s) with detailed equipment list, similar-to Foodservice Equipment Plans included in the Contract Drawings.

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Item numbers are to be the same as shown in the Contract Documents and are to include Spare Numbers and associated items provided by others.

7. In the event rough-ins have been accomplished before award of this contract, Contractor is to examine the existing facility and identify adjustment needs related to their equipment to suit building conditions and utilities, where possible. Contractor to seek approval for the same prior to further construction. If not possible, state so in a letter, with reasons and an alternate method and pricing for their equipment, to the Architect and Foodservice Consultant.

F. Shop Drawings:

1. Submit shop drawings for items of custom fabrication included in this contract in pdf format. Shop drawings are to be submitted at 3/4" (1:20) and/or 1-1/2" (1:10) scale and are to show dimensions, materials, finishes, details of construction, installation and relation of adjoining work requiring cutting or close fitting as well as any specified fabrication shop fit-out work such as electrical load circuit breaker panels, inter-wiring or inter-piping. Shop drawings are to also indicate reinforcements, anchorage and related work required for the complete installation of fixtures. Fabricator's shop drawings shall be prepared as a coordinated single submittal, separate-from, and not part of a single collated foodservice submittal.
2. Submit shop drawings for any equipment requiring field assembly, including but not limited to, Suite-style cooking assemblies, pulper/extractor assemblies, remote refrigeration systems, walk-in coolers and/or freezers, exhaust hoods/ventilators, fire suppression system, utility distribution systems, pot/utility/cart/tray/ware washing assemblies/machines, conveyors, floor troughs, seismic anchoring details (as required) and fresh oil supply/waste oil recovery systems in pdf format. Manufacturer's shop drawings shall be separated per system submitted in single form, and not part of a collated foodservice submittal.
3. When applicable, prepare and submit section, elevation, axonometric drawings in PDF format for all food shields within counters in a coordinated single submittal. Food shields to be compliant with current NSF code requirements and ergonomic reach requirements. Contractor to provide physical mock-up of same for Owner/Operator review and sign-off prior to fabrication.
4. Before proceeding with the fabrication or manufacture of any item, Contractor is responsible for verifying and coordinating all dimensions and details with site dimensions, conditions, and adjacent equipment.
5. The Contractor to clearly identify on drawings any-and-all differences between the Bid and/or Contract Documents and what is being provided. If any structural, electrical, plumbing, gas or steam requirements are different than what the Bid and/or Contract Documents show the Contractor will notify and record on the drawings identifying what is different and discuss same with General Contractor, Owner and Foodservice Consultant prior to commencing work.

G. Product Data Submittal Manuals:

1. Submit product data brochure(s) with a cover sheet complete with detailed information on every item included in this section in pdf format. Detailed information is to include, but not be limited to, item number, description, quantity, model numbers, options and accessories provided, N.E.M.A. plug and receptacle configuration for applicable items, exact utility requirements, manufacturer's cut-sheets, reference to specific shop drawings, etc. Distribute one additional copy of installation and start-up instructions to the Installer. Every cover sheet and associated detailed submittal is to provide sufficient and complete information for the Design Team to verify that the Contractor understands the Contract requirements and is providing each item in compliance with the Contract Documents. Cover sheets to also include associated items as listed on the Equipment Plan but provided by others; and are to be noted as "Not in Section 11 40 00 Contract Division".
2. Reproduction of any part of the Contract Specifications will not be acceptable as part or total of Contractor's Product Data Submittal Manuals. These Manuals are to be produced and assembled entirely by the Contractor, in numerical order according to Item numbers.
3. The cover sheet shall clearly identify all differences between the bid documents and what is being provided. If any electrical, plumbing, gas or steam requirements are different than what the bid documents show the Contractor will make a note on the coversheet identifying what is different and why. If a model has been discontinued, the Contractor will make a note on the cover sheet and offer a replacement model.
4. The cover sheet shall clearly identify all differences between the Bid/Contract Documents and what is being provided. If any electrical, plumbing, gas or steam requirements are different than what the bid documents show the Contractor will make a note on the coversheet identifying what is different and why. If a model has been discontinued, the Contractor will make a note on the cover sheet and offer a replacement model.

H. The Design Team's review of submittal drawings, shop details, product data brochures, and operation and maintenance manuals are for general conformance with the design concept and Contract Documents. Review markings or comments are not to be construed as relieving Contractor from compliance with the Contract Documents, or departures there from. Contractor remains responsible for details and accuracy, confirming and correlating all quantities and dimensions, selecting fabrication processes, techniques of assembly, and performing their work in a safe, satisfactory, code-compliant and professional manner.

I. Commencement of purchasing or fabrication by the Contractor, of any item(s) included in this Contract, prior to receipt of reviewed Submittals from the Design Team, shall be at the Contractor's own risk; unless specifically instructed to do so in writing by the Owner, including the specific item numbers requested.

- J. Contractor shall verify requirements and equipment sizes, critical clearances, or other characteristics necessary to represent Owner/ Purveyor items completely on the shop drawing submittals even though they may be listed as “NIC/Not in Contract” in the Equipment Schedule/Item Specification sections of this document.

1.11 OPERATION AND MAINTENANCE DATA MANUALS:

- A. Two (2) bound sets of manuals are to be furnished for items of standard manufacturer on/or before the date of the first event to occur of the following: demo/start-up, start-up for intended use by the Owner/Operator, completion of installation of kitchen equipment contract package, or final acceptance of installation by Owner. Manuals are to be in alphabetical order according to manufacturer. Manufacturer's info is to include Tech Services telephone number, email, and web site address, where available.
- B. Provide a complete list of all equipment, with make, model and serial numbers. Provide list of local service agencies for included manufacturers, complete with addresses, email addresses and telephone numbers. Also provide email and web site addresses, where available.
- C. Provide electronic/digital media for maintenance, training, operation, etc. where available from the manufacturer.
- D. Manual shall also include a leak testing report for each-and-every remote refrigerated system included under this Foodservice Equipment Section, as required in article 2.7.A.6 Refrigeration Equipment of this Section.

1.12 AS - BUILT/ RECORD DOCUMENTS:

- A. Maintain one record set of Foodservice Equipment Plans with any related corrections, revisions, additions, deletions, changes, etc. noted during construction and installation. Provide an "as-built" set on a computer disk or electronically in PDF format.
- B. Provide one (1) final set of Product Data Submittal Manual with any related corrections, revisions, additions, deletions, changes, etc. noted during construction and installation as a specifications' record set electronically in PDF format.
- C. These documents are to be provided at the same time as the O & M Data Manuals. Submit the O & M Data Manuals electronically in PDF format.

1.13 SCHEDULE:

- A. Time is of the essence and acceptance constitutes assurance that the Contractor can and will obtain materials, equipment, and manpower, to permit installation of the

items included in this Section, on schedule. Contractor is to coordinate their work with the progress schedule, as prepared and updated periodically by the General Contractor or Construction Manager.

- B. Anticipated delays, not within the control of the Contractor, are to be noted in a written notification to the Architect, immediately upon the Contractor's realization that delays are imminent.
- C. Failure of manufacturers to meet promised delivery dates will not grant relief to the Contractor for failure to meet schedules; unless the Contractor can establish, in writing, that orders were received by the manufacturer, with reasonable lead times.
- D. Extra charges resulting from special handling or air shipment in-order-to meet the schedule will be paid by the Contractor if insufficient time was allowed in placing factory orders.

1.14 WARRANTY:

- A. Unless otherwise noted in Related Divisions / Sections 1.3.A, items furnished are to be fully guaranteed against defects in workmanship, materials, and functionality for one full year from the date of the first event to occur of the following: date of issue of Certificate of Occupancy (or the equivalent), start-up for intended use by the Owner/Operator, completion of installation of kitchen equipment contract package, or final acceptance of installation by Owner. Should a Temporary Certificate of Occupancy be issued for partial completion of work, the items furnished within that designated area are to be under warranty from the date of issue of that Certificate. Contractor or their service agent will make necessary repairs and replacements without charge to the Owner, and within a reasonable time.
- B. Additional Refrigeration Warranty: in addition to the one-year warranty requirements as stated above, provide start-up and parts and labor for the first year, plus additional four-year extended warranty on compressors. Extended warranty is for provision of replacement compressor, determined to be defective by a certified refrigeration mechanic. However, verification of defective compressor, installation of replacement compressor, recharging and repairs of system will be the responsibility of the Owner. This includes all items with built-in or remote refrigeration system.
- C. Periodic routine maintenance, servicing, adjustments, cleaning, etc., as required by the manufacturers included in this Project, are the responsibility of the Owner.
- D. Any-and-all parts or requirements for manufacturer's warranties to be in effect, whether, or not noted in the itemized specifications, are to be provided or complied with by the Contractor. This is to include, but not be limited to, particular-parts, accessories, or installation; installation supervision, start-up, and/or follow-up inspections required by factory trained, Certified, and/or authorized personnel.

Factory training, Certification, and/or authorization is to be in effect at the time of bidding, installation, start-up, and warranty period of this Project.

- E. Unless otherwise noted in Related Divisions manufacturer's warranties which comply with the requirements of this Warranty Article 1.14, are to be provided in lieu of Contractor's own warranties, where available. Copies of the written warranties are to be included in the O & M Manuals.

PART 2 – PRODUCTS

2.1 EQUIPMENT:

- A. Refer to schedule on Foodservice Drawings and Section 3.12 Itemized Specifications for equipment included in this Section.

2.2 MATERIALS:

- A. Metals:
 - 1. Stainless-Steel: AISI Type 201 or 302/304, hardest workable temper, and No.4 directional polish. Unless otherwise noted or specified, or required by the manufacturer, 201 may be used wherever 302/304 is listed.
 - 2. Galvanized Steel Sheet: ASTM A526, except ASTM A527 for extensive forming; ASTM A525, G90 zinc coating, chemical treatment.
 - a. Where painted finish is indicated, provide mill phosphatized treatment in lieu of chemical treatment.
 - 3. Steel Sheet: ASTM A569 hot-rolled carbon steel.
 - 4. Galvanized Steel Pipe: ASTM A53 or ASTM A120, welded or seamless, schedule 40, galvanized.
 - 5. Steel-Structural Members: Hot rolled or cold formed, carbon steel unless stainless-steel is indicated.
 - a. Galvanized Finish (G.I.): ASTM A123 hot-dipped zinc coating, applied after fabrication.
 - 6. Aluminum: ASTM B209/B221 sheet, plate, and extrusions (as indicated); alloy, temper and finish as determined by manufacturer/fabricator, except 0.40-mil natural anodized finish on exposed work unless another finish is indicated.
- B. Plastic Laminate: NEMA LD3, Type 2, 0.050" (1.27 mm) thick, except Type 3, 0.042" (1.07 mm) for post-forming smooth (non-textured). Color and texture as selected by Architect/ Interior Designer.
 - 1. Comply with NSF Standard No. 35.
 - 2. Veneered with approved waterproof and heat proof cement. Rubber base adhesives are not acceptable.
 - 3. Applied directly over close grained plywood, such as solid Mahogany or solid Birch, of selected, smooth, sanded stock to ensure a smooth ripple-free

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- laminated surface; or commercial grade furniture particle board, Cortron or equal.
4. Exposed faces and edges are to be faced with 1/16" (1.6 mm) thick material. Corresponding backs are to be covered with approved backing and balancing sheet material.
- C. Millwork: No unfinished millwork, plywood/particle board or wood framing (including backs, undersides, and all surfaces concealed from view) will be permitted. All unfinished surfaces or openings cut through finished surfaces are to be sealed to be water resistant; with excess plastic laminate material, Cortron (Melamine) material, backing materials, sealers, primers, finish paint, etc., to blend with specified finish materials.
- D. Hardwood Work Surfaces: Laminated edge grained hard maple (*Acer saccharum*), NHLA First Grade with knots, holes and other blemishes culled out, kiln dried at 8 percent or less moisture, waterproof glue, machined, sanded, and finished with NSF approved oil-sealer.
- E. Solid Surface Material and Simulated/Engineered Stone:
1. Single-Source Responsibility for Solid Surface Material and Simulated/Engineered Stone: Obtain each color, grade, finish, type, and variety of material or stone from a supplier with resources to provide materials of consistent quality in appearance and physical properties, including the capacity to cut and finish material without delaying the progress of the work.
 2. Single-Source Responsibility for Other Materials: Obtain each type of solid surface material and simulated/engineered stone accessory, sealant, and other materials from one manufacturer for each product.
 3. Installer Qualifications: Trained and approved by countertop manufacturer who has completed countertops similar in material, design, and extent to that indicated for project that has resulted in construction with a record of successful in-service performance.
 4. The Contractor is responsible for verification of delivered stone materials for quantities, defects, or damage within [ten (10) days] after delivery. No compensation will be allowed to the contractor for materials and labor that may be required to replace materials after this time-period.
 5. Allowable Tolerances:
 - a. Variation in component size: +/- 1/8 inch (3 mm) in 8 feet (2.4 m).
 - b. Maximum height of abrupt irregularities: 1/32 inch (.8 m).
 - c. Location of openings: +/- 1/8 inch (3 mm) from indicated location.
 6. Do not deliver countertop materials until painting and similar operations that could damage engineered stone materials have been completed in installation areas. If engineered stone materials must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

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7. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.
8. Environmental Limitations: Do not deliver or install simulated stone materials until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
 - a. Maintain ambient temperature between 50 and 95 degrees F. for 48 hours before, during and for minimum 7 days after installation.
9. Field Measurements: Where simulated stone materials are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - a. Locate concealed framing, blocking, and reinforcements that support simulated stonework by field measurements before being enclosed and indicate measurements on Shop Drawings.
10. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
11. Adhesive and Sealant as recommended by engineered stone manufacturer.
12. Sink/bowl mounting hardware:
 - a. Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of under-mount sinks/bowls.
13. Fabrication:
 - a. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions. Clean surfaces to remove loose and foreign matter that could impair adhesion.
 - b. Remove ridges and projections. Fill voids and depressions with patching compound compatible with setting materials.
 - c. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.
 - d. Rout and finish component edges with clean, sharp returns. Rout cutouts, radii and contours to template. Smooth edges. Repair or reject defective and inaccurate work.
 - e. Provide materials with ample allowance for cutting, when required to cut and fit on site. Provide trip for scribing and site cutting.
 - f. Thickness: Provide thickness indicated, but not less than the following:
 - i. Countertop: [3/4] (19 mm) [1-1/4] inch[es] (32 mm)
 - ii. Back and End Splashes: 3/4 inch (19 mm), unless shown otherwise.

iii. Substrate: [3/4] (19 mm)

F. Stone:

1. Single-Source Responsibility for Stone: Obtain each color, grade, finish, type, and variety of stone from a supplier with resources to provide materials of consistent quality in appearance and physical properties, including the capacity to cut and finish material without delaying the progress of the work.
2. Single-Source Responsibility for Other Materials: Obtain each type of stone accessory, sealant, and other materials from one manufacturer for each product.
3. Installer Qualifications: Engage an experienced installer who have completed stone countertops similar in material, design, and extent to that indicated for project that has resulted in construction with a record of successful in-service performance.
4. The Contractor is responsible for verification of delivered stone materials for quantities, defects, or damage within ten (10) days after delivery. No compensation will be allowed to the contractor for materials and labor that may be required to replace materials after this time-period.
5. Allowable Tolerances:
 - a. Variation in component size: +/- 1/8 inch (3 mm) in 8 feet (2.4 m).
 - b. Maximum height of abrupt irregularities: 1/32 inch (.8 mm).
 - c. Location of openings: +/- 1/8 inch (3 mm) from indicated location.
6. Granite materials shall not contain unsafe levels of radioactive materials.
7. Do not deliver countertop materials until painting and similar operations that could damage stone materials have been completed in installation areas. If stone materials must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
8. Deliver materials to project site in undamaged condition.
9. Store and handle stone and related materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, chipping, or other causes.
 - a. Do not use pinch or wrecking bars.
 - b. Lift with wide-belt-type slings where possible. Do not use wire rope or ropes containing tar or other substances that might cause staining. If required to move stone, use wood rollers with cushions at end of wood slides.
 - c. Store stone on wood skids or pallets covered with non-staining, waterproof membrane.
 - d. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones.
 - e. Protect stored stone from weather with waterproof, non-staining covers or enclosures, but allow air to circulate around stones.
 - f. Store cementitious materials off the ground, under cover, and in dry location.
10. Environmental Limitations: Do not deliver or install stone materials until building is enclosed, wet work is complete, and HVAC system is operating

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and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- a. Maintain ambient temperature between 50 and 95 degrees F. for 48 hours before, during and for minimum 7 days after installation.
11. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
 - a. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating countertops without field measurements. Provide allowance for trimming at site and coordinate construction to ensure actual dimensions correspond to established dimensions.
12. Comply with referenced standards and other requirements indicated applicable to each type of material required.
13. Provide matched slabs, coordinated for each type, variety, color, and quality of stone required.
14. The use of colored tints, dyes, or waxes applied to stone shall NOT be permitted.
15. Granite:
 - a. Granite Building Stone Standard: ASTM C615, free from cracks, chips, stains, or other defects, uniform in tone and coloring.
16. Marble:
 - a. Marble Building Stone Standard: ASTM C503, free from cracks, chips, stains, or other defects, uniform in tone and coloring.
17. Adhesives:
 - a. Stone Seam Adhesive: 2-part, epoxy or polyester stone adhesive formulated specifically for bonding stone to stone, with an initial set time of not more than 2 hours at 70 deg F.
 - b. Water-cleanable Epoxy Adhesive: ANSI A118.3, water-cleanable, tile-setting epoxy adhesive.
 - c. Color: Clear
 - d. Use installation adhesives that have a VOC content 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), or as listed in VOC limit tables in Section 01 81 19 "Indoor Air Quality Requirements". Products furnished shall comply with whichever VOC content requirement is more stringent.
18. Stone Sealants:
 - a. Sealant for Countertops: Clear silicone sealant complying with requirements of Section 07 92 00 "Joint Sealants".
 - b. For sealants used inside of the vapor barrier, provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), or as listed in VOC limit tables in Section 01 81 19 "Indoor Air Quality Requirements". Products furnished shall comply with whichever VOC content requirement is more stringent.
19. Stone Sealers:

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- a. Penetrating Sealer: Penetrating sealer that protects the exposed faces of stone and grout from staining. Sealer shall be UV transparent; non-yellowing; VOC compliant; mold and mildew resistant; and USDA approved as safe on food handling surfaces. Material shall exceed ADA standards for slip resistance at traffic areas.
 - b. For sealers used inside of the vapor barrier, provide sealers that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), or as listed in VOC limit tables in Section 01 81 19 "Indoor Air Quality Requirements". Products furnished shall comply with whichever VOC content requirement is more stringent.
20. Cutouts and Holes for Lavatories, Sinks, and Fittings:
- a. Undercounter Lavatories: Make cutouts for undercounter lavatories in shop using template or pattern furnished by lavatory manufacturer. Form cutouts to smooth, even curves with edges at right angles to top. Ease juncture of cutout edges with tops, and finish edges to match tops.
21. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
- G. Insulation:
- 1. For low temperature applications, such as ice bins, cold pans, or fabricated under counter freezers, use urethane, rigid board foam or foamed-in-place; not less than 2" (50 mm) thick, except that vertical surfaces of cold pans and ice bins may be 1" (25 mm) thick. Insulation to be bonded at joints, to prevent condensation on exterior.
 - 2. For refrigerated applications such as fabricated under counter refrigerators, use urethane rigid board foam or foamed-in-place, or Styrofoam rigid board foam 2" (50 mm) thick, bonded at joints. No fiberglass insulation will be permitted.
 - 3. For heated type applications, such as plate warmers, use block type rock wool, minimum 1" (25 mm) thick; or Marinite I as noted in #4 below.
 - 4. At counters with tops subject to direct or indirect heat from heating or cooking-equipment, provide heat-resistant, food-safe caulking, three (3) layers of Nomex insulation held-in-place with aluminum tape. Provide a 1/8" (3 mm) minimum space between the heat source and the insulation. Coordinate drop-in equipment flange support and provide a 16-gauge stainless-steel 90-degree angle collar.
 - 5. All insulation is to be fully encased or enclosed in 16-gauge (1.6 mm) stainless-steel.
- H. Joint Materials:
- 1. Sealants: waterproof and mildew resistant silicone sealant, with Shore A hardness of 30, except 45 if subject to traffic, and minimum service temperature range of -60° to +400° F. Sealant to be NSF Standard #51 Listed, and FDA and USDA Approved for use in food zones. Surfaces, cleaning, and sealants installation to comply with applicable requirements of

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FDA, USDA, and NSF Standards, and accepted foodservice installation practices.

2. Backer Rod: For 3/8" (9.5 mm) or larger joints, to be polyurethane rod stock, larger than joint width.
3. Gaskets: Solid or hollow (but not cellular) neoprene or polyvinyl chloride; light grey, minimum of 40 Shore A hardness, self-adhesive or prepared for either adhesive application or mechanical anchorage.

I. Paint and Coatings:

1. Provide the types of painting and coating materials which, after drying or curing, are suitable for use in conjunction with foodservice, and which are durable, non-toxic, non-dusting, non-flaking, mildew resistant, and comply with NSF Standards and governing regulations for foodservice.
2. Galvanize Repair Paint: MIL-P-21035.
3. Sound Deadener: NSF-listed sound deadening material such as latex sound deadener, for internal surfaces of metal work, and underside of metal counters and tables between work top and underbracing. Verify sound deadening requirements or restrictions with local health authorities.
4. Pretreatment: SSPC-PT2 or PT3, of FS TT-C490.
5. Primer Coating for Metal: FS TT-P-86, type suitable for baking, where indicated.
6. Enamel for Metal: Synthetic type, FA TT-P-491, type suitable for baking, where indicated.

2.3 FABRICATED PRODUCTS:

- A. Hardware (also refer to article 2.4 Fabrication of Metal Work in general, and paragraphs O. Doors 1-3 and P. Drawer Assemblies 1-6 specifically, for additional requirements):
1. General: Manufacturer's standard, but not less than ANSI 156.9 Type 2 (Institutional), satin finish stainless-steel or dull chrome finish on brass, bronze, or steel.
 2. Hinged Door Hardware: Stainless-steel hinged doors to be mounted with heavy duty NSF-approved hinges with Component Hardware Group, Model No. P62-1010 pulls, or equal; or full length pulls as per individual itemized specifications and shown on Standard Detail FSD1-24. Catches to be heavy-duty magnetic type, except as otherwise indicated. Millwork cabinet hinged doors to be mounted with Blum 95° CLIP top thick door all metal hinges, nickel plated, with 3-dimensional adjustment, or equal, or as per individual itemized specifications.
 3. Drawer Hardware: Slides to be 200 pounds (90 kilograms) minimum capacity per pair, 201 or 300 series stainless-steel, full extension, side-mounting, self-closing type, with stainless-steel ball-bearings, and positive stops; Component Hardware Group Series S52, or equal. Pulls to be Component Hardware Group, Model No. P62-1012, or equal; or full length pulls as per individual itemized specifications and shown on Standard Detail FSD1-24.

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4. Sliding Door Hardware: Sliding doors to be mounted on large, quiet ball bearing rollers in 14-gauge (2 mm) stainless-steel overhead tracks and be removable without the use of tools. Bottom of cabinet to have stainless-steel guide-pins and not channel tracks for doors.
5. All hardware to be identified with manufacturer's name and number, so that broken or worn parts may be replaced.

B. Casters:

1. Type and size as recommended by caster manufacturer, NSF- approved for the type and weight of equipment supported; normally 5" (127 mm) diameter heavy-duty, ball-bearing, solid or disc wheel with non-marking grease proof rubber, neoprene or polyurethane tire; unless otherwise specified. Minimum width of tread to be 1-3/16" (30 mm). Minimum capacity per caster to be 250-pound (113.4kg), unless otherwise noted in itemized specifications.
2. Solid material wheels to be provided with stainless-steel rotating wheel guard.
3. Wheel and swivel bearings shall be sealed and show a polished plated finish per NSF.
4. Unless otherwise indicated, equip each item with two (2) swivel type casters and two (2) fixed casters, with foot brakes on two (2) casters.
5. Unless item is equipped with another form of all-around protective bumper, provide circular rotating bumper above each caster, 5" (127 mm) diameter tire of light grey synthetic rubber (hollow or closed-cell) on cadmium-plated disc.

C. Plumbing Fittings, Trim and Accessories:

1. General: Where exposed or semi-exposed, provide bright chrome plated brass or polished stainless-steel units. Provide copper or brass where not exposed.
2. Vacuum Breakers: Provide with foodservice equipment as listed in the itemized specifications.
3. Water Outlets: At sinks and at other locations where water is supplied (by manual, automatic or remote control), furnish commercial quality faucets, valves, dispensers or fill devices, of the type and size indicated, and as required to operate as indicated.
4. Waste Fittings: Except as otherwise indicated, furnish 2" (50 mm) remote-lever ball valve type waste valve, and 3-1/2" (89 mm) flat strainer.
5. Also refer to article 2.4.K for additional information.

D. Electrical Materials:

1. General: Provide standard materials, devices and components as recommended by the manufacturer or fabricator, selected, and installed in accordance with N.E.M.A. standards and recommendations; and as required for safe and efficient use and operation of the foodservice equipment, without sanitation concerns.
2. Components to bear the U.L. label or be approved by the prevailing authority.

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3. Custom fabricated refrigerated/freezer units to be provided with vapor tight light receptacles, shatterproof lamps and automatic switches. Wiring to be concealed.
4. Where light fixtures are specified or detailed as part of counters, cases or fixtures; light fixtures with lamps to be furnished and installed. Warm white lamps to be provided, unless otherwise specified. If fluorescent light fixtures are specified, ballasts and tubes to be provided. Shields to be provided for all light fixtures.
5. Convenience and Power Receptacles: Make cutouts and install appropriate boxes or receptacles in fabricated fixtures, complete with wiring, conduit, receptacle, and stainless-steel cover plate. Receptacles and plugs to conform to N.E.M.A. standards. Electrical receptacles and devices to be first quality "Specification Grade". GFCI receptacles to be furnished as per the National Electrical Code.
6. Plugs and Cords: Where cords and plugs are provided, they are to comply with National Electrical Manufacturer's Association (N.E.M.A.) requirements. Indicate N.E.M.A. configuration for each applicable item.
7. Power Characteristics: Refer to Electrical Divisions specifications for project power characteristics. Also, refer to individual equipment requirements, for loads and ratings.
8. All electrical components (J-boxes, conduit, receptacles, switches, cover plates, light fixtures, panels, etc.) built into or on any equipment provided by Contractor, other than standard buy-out factory manufactured equipment, are to be vapor or water-tight type. Provide buy-out equipment with vapor or water-tight electrical components wherever available.

2.4 FABRICATION OF METALWORK:

A. General Fabrication Requirements:

1. Remove burrs from sheared edges of metalwork, ease the corners and smooth to eliminate cutting hazard. Bend sheets of metal, at not less than the minimum radius required to avoid grain separation in the metal. Maintain flat, smooth surfaces, without damage to finish.
2. Reinforce metal at locations of hardware, anchorages, and accessory attachments wherever metal is less than 14-gauge (2 mm) or requires mortised application. Conceal reinforcements to the greatest extent possible. Weld in place, on concealed faces.
3. Exposed screws or bolt heads, rivets and butt joints made by riveting straps under seams and then filled with solder, will not be accepted. Where fasteners are permitted, provide Phillips-head, flat or oval head machine screws. Cap threads with acorn nuts and lock washers, unless fully concealed in inaccessible construction; and provide nuts and lockwashers unless metal for tapping is at least 12-gauge (2.5 mm). Match fastener head finish with finish of metal fastened.
4. Where components of fabricated metal work are indicated to be galvanized and involve welding or machining of metal heavier than 16-gauge (1.6 mm), complete the fabrication and provide hot-dip galvanizing of each component,

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after fabrication, to the greatest extent possible (depending upon available dip-tank sizes). Comply with ASTM A123.

5. Welding and Soldering:
 - a. Materials 18-gauge (1.3 mm), or heavier, to be welded.
 - b. Seams and joints to be shop welded or soldered as the nature of the material may require.
 - c. Welds to be ground smooth and polished to match original finish.
 - d. Where galvanizing has been burned off, the weld is to be cleaned and touched up with high grade aluminum paint.
6. Provide removable panels for access to mechanical and electrical service connections, which are concealed behind or within foodservice equipment, but only where access is not possible and not indicated through other work.
7. Where ends of fixtures, splashbacks, shelves, etc., are open, fill by forming the metal or welding sections, if necessary, to close entire opening flush to walls or adjoining fixtures.
8. Rolled edges are to be as detailed, with corners bullnosed, ground and polished.
9. Equipment to have 1/2" (12.7 mm) or larger radius coves in horizontal and vertical corners, and intersections, per NSF standards.

B. Metal and Gauges:

1. Except as otherwise indicated, fabricate exposed metalwork of stainless-steel; and fabricate the following components from the gauge of metal indicated, and other components from not less than 20-gauge (1 mm) metal:
 - a. Table and counter tops: 14-gauge (2 mm)
 - b. Sinks and drainboards: 14-gauge (2 mm)
 - c. Shelves: 16-gauge (1.6 mm)
 - d. Front drawer and door panels: 18-gauge (1.3 mm)
(double pan type)
 - e. Single pan doors and drawer fronts: 16-gauge (1.6 mm)
 - f. Enclosed base cabinets: 18-gauge (1.3 mm)
 - g. Enclosed wall cabinets: 16-gauge (1.3 mm)
 - h. Exhaust hoods and ventilators: 18-gauge (1.3 mm)
 - i. Pan-type insets and trays: 16-gauge (1.6 mm)
 - j. Removable covers and panels: 18-gauge (1.3 mm)
 - k. Skirts and enclosure panels: 18-gauge (1.3 mm)
 - l. Closure/trim strips over 4" (102 mm) wide: 18-gauge (1.3 mm)
 - m. Hardware reinforcement: 12-gauge (2.5 mm)
 - n. Gusset plates: 10-gauge (3.4 mm)
 - o. Removable toe kicks: 14-gauge (3.4 mm)
 - p. Wall flashing 20-gauge (.95 mm)

C. Work-Surface Fabrication:

1. Fabricate metal work surfaces by forming and welding, to provide seamless construction using welding rods matching sheet metal, grinding and polishing. Where necessary for disassembly, provide waterproof gasketed draw-type joints with concealed bolting.

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2. Reinforce work surfaces 30" (762 mm) on center both ways, with galvanized or stainless-steel concealed structural members. Reinforce edges, which are not self-reinforced, by formed edges.
- D. Metal Top Construction:
1. Metal tops to be one-piece welded construction, including field joints. Secure to a full perimeter galvanized steel channel frame cross-braced not farther than 30" (762 mm) on center. Fasten top with stud bolts or tack welds. If hat sections are used in lieu of channels, close ends.
 2. Properly designed draw fastening, trim strip, or commercial joint material to suit requirement is to be used, only if specified.
- E. Structural Framing:
1. Except as otherwise indicated, provide framing of minimum 1" (25 mm) pipe-size round pipe or tube members, with mitered and welded joints and gusset plates, ground smooth. Provide 14-gauge (2 mm) stainless-steel tube for exposed framing, and galvanized steel pipe for concealed framing.
 2. Where indicated, flange rear and end edges up to form splashes integrally with top, with vertical and horizontal corners coved of not less than 1/4" (6 mm) radius, die formed. Turn back splashes 1" (25 mm) to wall across top and ends with rounded edge on break, unless otherwise specified.
 3. For die-crimped edges, use inverted "V" 1/2" (13 mm) deep inside and 2" (50 mm) deep on outside, unless otherwise shown. For straight down flanges, make 1-3/4" (45 mm) deep on outside. For bullnose edges, roll down 1-3/4" (45 mm).
 4. Edges: die-formed, integral with top. For rounded corners, form to 1" (25 mm) radius, weld, and polish to original finish.
- F. Field Joints: For any field joint required because of size of fixture; butt-joint, reinforce on underside with angles of same material, bolt together with non-corrosive bolts and nuts, field-weld, grind, and polish to a seam not visible to the naked eye.
- G. Pipe Bases: Construct pipe bases of 1-5/8" (41 mm) diameter 18-gauge (1.3 mm) stainless-steel tubing. Fit legs with polished stainless-steel sanitary adjustable bullet feet to provide for not less than 2" (50 mm) of vertical adjustment without exposing threads. Space legs to provide ample support for tops, precluding any possibility of buckling or sagging and in no case more than 6' -0" (1829 mm) centers.
- H. Legs and Cross rails
1. Equipment legs and cross rails to be 1-5/8" (41 mm), 16-gauge (1.6 mm) stainless-steel tubing.
 2. Welds at cross rails to be continuous and ground smooth. Tack welds will not be acceptable.
 3. Bottom of legs to be hugged inward and fitted with a stainless-steel bullet-type foot with not less than 2" (50 mm) vertical adjustment without exposing threads.
 4. Free standing legs or legs on island tables/counters with electrical/plumbing

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connections to be anchored to floor with bolt-down type flanged feet with stainless-steel fasteners.

5. Components:
 - a. Steel Gusset: Stainless-steel exterior to fit 1-5/8" (41 mm) tubing, with Allen screw for fastening and adjustment. Not less than 3" (76 mm) diameter at top and 3-3/4" (95mm) long. Outer shell 16-gauge (1.6 mm) stainless-steel, reinforced with 12-gauge (2.5 mm) mild steel insert welded interior shell, or approved equal.
 - b. Stainless-Steel Low Counter Legs: Stainless-steel exterior 5-3/4" (146 mm) minimum, 7" (178 mm) maximum length with stainless-steel 3-1/2" (89 mm) square plate with four countersunk holes, welded to top for fastening.
 - c. Stainless-Steel Adjustable Foot: Stainless-steel 1-1/2" (37 mm) diameter tapered at bottom to 1" (25 mm) diameter, fitted with threaded cold rolled rod for minimum 1-1/2" (37 mm) diameter x 3/4" (19 mm) threaded bushing plug welded to legs, or approved equal. Push-in foot not acceptable.
 6. Legs to be fastened to equipment with gussets, as follows:
 - a. Sinks: Reinforced with bushings and set screw.
 - b. Metal Top Tables and Dish Tables: Welded to galvanized steel channels, 14-gauge (2 mm) or heavier, anchored to top with screws through slotted holes.
 - c. Wood Top Tables: Welded to stainless-steel channels, 14-gauge (2 mm) or heavier, anchored to top with screws through slotted holes.
- I. Shelves:
1. Construct solid shelves under pipe base tables of 16-gauge (1.6 mm) stainless-steel, with 1-1/2" (37 mm) turned down and under edges on exposed sides, and 2" (50 mm) turn up against walls or equipment. Fully weld to pipe legs.
 2. In fixtures with enclosed bases, turn up shelves on back and sides with 1/4" (6 mm) (minimum) radius and feather slightly to ensure a tight fit to enclosure panels.
- J. Sinks:
1. Construct sinks of 14-gauge (2 mm) stainless-steel with No.4 finish inside and outside.
 2. Form back, bottom and front of one piece, with ends and partitions welded into place. Partitions: double thickness, 2" (51 mm) minimum space between walls. Multiple compartments to be continuous on the exterior, without applied facing strips or panels.
 3. Cove interior vertical and horizontal corners of each tub not less than 1/4" (6 mm) radius, die formed. Outer ends of drainboards to have roll rim risers not less than 3" (76 mm) high.
 4. Drill faucet holes in splashes 2-1/2" (63.5 mm) below top edge. Verify center spacing with faucet specified. Grind and polish.

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5. Sink insets to be deep drawn of 16-gauge (1.6 mm), or heavier, polished stainless-steel. Weld into sink drainboards with 1-1/2" (37 mm) x 1-1/2" (37 mm) x 14-gauge (2 mm) stainless-steel angle brackets; securely welded to sinks and galvanized cross angles spot welded to underside of drainboards to form an integral part of the installation.
 6. The bottom of each compartment is to be creased such as to ensure complete drainage to waste opening. Slope bottom of sink bowls toward drain outlet.
- K. Drains and Wastes and Faucets:
1. Furnish and install Fisher model 28940, or equal, ball valve type rotary drain assembly with flat strainer and connected overflow assembly, with chrome finish, in die-drawn inset type sinks and Bain Marie sinks.
 2. Other custom fabricated sinks to be furnished with Fisher model 28932, or equal, ball valve-type rotary drain assembly, with flat strainer and chrome finish. Waste connection to have 2" (50 mm) external thread size, with 1-1/2" (37 mm) internal thread size.
 3. Rotary Handle: Of sufficient length to extend to front edge of sink. No riveting, screws or soldering permitted to fit drains to sinks, with all parts of drains easily removable for servicing and replacement.
 4. All faucets furnished with equipment included in this Section to be lead-free and comply with NSF Standard #61, Section #9; such as manufactured by Fisher, Chicago, or T&S.
 5. Faucets and pre-rinse spray assemblies furnished with equipment included in this Section, are to have a maximum GPM flow rate in compliance with the Energy Policy Act of 2005 (EPAct) and later updates; or local requirements, whichever is lower. EPAct / local requirements are to be applicable to all faucets and pre-rinses; except for pre-rinse type assemblies used at glass icing / fill stations, fill hose / faucet assemblies at high water usage cooking equipment such as kettles, tilt fry pans, etc., and fill faucets at high volume / usage sinks, such as pot wash, mop sink and preparation sinks, etc. are to have flow rates of approximately 5 gpm flow minimum.
 6. All flex hose type faucet assemblies, such as pre-rinses, kettle fill hoses, etc., to have an inline pressure type back-flow preventer in the hose assembly, as required by local codes.
 7. All equipment provided by this Contractor, which discharges liquid waste exceeding 140° F (60° C), is to be provided with a cold-water drain tempering assembly per local codes.
- L. Workmanship:
1. Best quality in the trade. Field-verify dimensions before fabricating; conform all items to dimensions of building; neatly fit around pipes, offsets and other obstructions.
 2. Fabricate only in accordance with approved shop drawings, showing pipes, obstructions to be built around, and location of utilities and services.

M. Casework:

1. Enclosure: except as otherwise indicated, provide each unit of casework (base, wall, overhead and free-standing) with a complete-enclosure metal cabinet, including fronts, backs, tops, bottoms, and sides.
2. Bases to be made of 18-gauge (1.3 mm) stainless-steel sheets reinforced by forming the metal and the inclusion of hat-channels.
3. Ends, partitions and shelves to be stainless-steel.
4. Unexposed backs and structural members may be galvanized, unless otherwise noted.
5. Vertical ends and partitions to be single wall, with a 2" (50 mm) face.
6. Sides and through partitions are flush with bottom rail, welded at intersections.
7. Shelves: Provide adjustable standards for positioning and support of shelves in casework; except bottom shelf of cabinet mounted on legs or as specified. Turn back of shelf units up 2" (50 mm) and hem. Turn other edges down to form open channel. Reinforce shelf units and pilasters to support 40 pounds per square foot (195 kgs/sq meter) loading, plus 100 percent impact loading.
8. Bottom front rail of bases set on masonry platform to be continuously closed and sealed to platform.
9. Provide removable access hatchways to all concealed floor sinks under casework directly over floor sinks. Sink locations to conform to local Health Department code requirements.

N. Doors:

1. Metal doors to be double-cased stainless-steel. Outer pans to be 18-gauge (1.3 mm) stainless-steel with corners welded, ground smooth and polished. Inner pan to be 20-gauge (1 mm) stainless-steel fitted tightly into outer pan with a sound deadening material such as Celotex or Styrofoam used as a core. The two pans to be tack welded together and joints solder filled. Doors to finish approximately 3/4" (19 mm) thick and be fitted with flush recessed type stainless-steel door pulls; or full-length continuous pulls as per individual itemized specifications and shown on applicable Standard Detail sheet.
2. Wood doors to be fabricated as detailed.
3. Hinged doors to be mounted on heavy-duty NSF-approved hinges, or as noted on plans or specifications.

O. Drawer Assemblies:

1. Assemblies to consist of removable drawer body mounted in a ball bearing slide assembly with fully enclosed housing.
2. Slide assembly consists of one pair of 200-pound (90 kilograms) capacity stainless-steel roller bearing full extension slides, with side and back enclosure panels, front spacer angle, two drawer carrier angles, secured to slides and stainless-steel front.

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3. Drawers intended for tools and general non-food products storage are to have 20" x 20" x 6" deep (508 mm x 508 mm x 152 mm), 18-gauge (1.3 mm) minimum stainless-steel drawer pans.
 4. Drawers intended to hold food products are to have 12" x 20" x 6" deep (305 mm x 508 mm x 152 mm) stainless-steel food pans.
 5. All drawer pans to be easily removable without tools or disassembly of any drawer assembly components.
 6. Drawer fronts are double-cased, 3/4" (19 mm) thick, with 18-gauge (1.3 mm) stainless-steel welded and polished front pan. Steel back pan shall be tightly fitted, and tack welded. Sound-deaden with rigid insulation material.
 7. Provide drawers with replaceable soft neoprene bumpers or for refrigerated drawers - a full perimeter replaceable refrigerator gasket.
- P. Closed Base: Where casework is indicated to be located on a raised-floor base, prepare casework for support without legs, and for anchorage and sealant application, as required for a completely enclosed and concealed base.
- Q. Support from Floor: Equip floor supported mobile units with casters, and equip items indicated as roll-out units, with manufacturer's standard one-directional rollers. Otherwise, and except for closed-base units, provide pipe or tube legs, with adjustable bullet-design feet for floor supported items of fabricated metalwork. Provide 2" (50 mm) vertical adjustment of feet (concealed threading).
- R. Shop Painting:
1. Clean and prepare metal surfaces to be painted; remove rust and dirt. Apply treatment to zinc coated surfaces, which have not been mill phosphatized. Coat welded and abraded areas of zinc coated surfaces, with galvanize repair paint.
 2. Apply 1.5 mil (dry film thickness) metal primer coating, followed by 2, 1.0 mil (dry film thickness) metal enamel finish coatings.
 3. Bake primer and finish coatings in accordance with paint manufacturer's instructions for a baked enamel finish.
- S. Sound Deadening:
1. Sound-deaden underside of metal tops, drainboards, undershelves, cabinet interior shelves, etc., above the underbracing/reinforcing/framing only.
- 2.5 ARCHITECTURAL MILLWORK EQUIPMENT:
- A. The following general requirements shall govern the construction of millwork-built fixtures, except where otherwise noted. Work shall be performed by skilled mechanics of the trade and shall be of the highest quality throughout, in such a manner as to fulfill the intent of the Contract Documents. Perform architectural woodwork in accordance with "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI). Fabricator shall have a

demonstrated ability in fabricating woodwork items similar in type and quality to those required for this project.

1. All fixtures shall be made by one manufacturer and assembled in single and complete units as the dimensions will permit shipment to and installation of at the building. Large pieces requiring sectional construction shall have their parts accurately fitted and aligned with all others, and provided with ample screws, glue and bolt blocks, tongues, grooves and splines, dowels, mortises and tenons, screws bolts or suitable means of concealed fastening, as required to render the work substantial, rigid and permanently secured in proper position to each related section.
2. Sufficient additional material shall be allowed to permit accurate scribing to walls, floor and related work, and due allowance made whenever possible for such shrinkage as may develop after installation. Single and sectional units shall be provided with adequate cleating, blocking, crating and other forms of protection as required precluding damage during shipping and handling.
3. Framing and blocking members shall be assembled with bolted and screwed connections and should be secured to the structural backing with cinch, expansion screws or toggle bolts, as required; spaced and installed to insure ample strength and rigidity. Rails and stiles shall be mortised and tenoned, work neatly mitered and membered, all butt joints made flush and smooth, and all permanent joints made up with water resistant glue. All fixtures shall be assembled without face screws or nails, except where it may be necessary to attach items. All face screws or nails which are necessary shall be counter sunk and plastic wood or wood plugs used to cover head, and the plug neatly touched up. The heads of all screws used in any assembly shall be counter sunk below the surface.
4. The core material shall be marine-grade, 7 ply-substrate or MEDEX exterior resin medium density fiberboard substrate; conform to ANSI A208.2.3.3.4. All substrate materials shall be LEED certified and meet the LEED requirements for the project.
5. Back sheet shall be NEMA LD .020" (0.5 mm) thick, Type V, Grade 91 plastic laminate; apply on all surfaces not covered with plastic laminate; coordinate color with exposed surface color; comply with NSF Standard 35.

B. Construction / Joints:

1. Follow AWI Premium Grade Standards; factory assembled parts and prefinished; flush type fronts and overlapping ends; ¾" (19 mm) core material base cabinet, end and dividers with corner joints between framed members fully lock-jointed, glued and screwed; dado and glue cabinet backs into sides and bottom; scribe countertop and backsplashes; secure countertops to base cabinet from underside; fully cure surfaces prior to installation. Mortise and tenon, spline, dowel and/or pin lock and glue work to avoid use of nails wherever practical. Make butt joints with an approved device for prevention of separation of members. Blind nail and conceal.

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C. Plastic Laminate:

1. Plastic laminate shall be bonded to all exposed surfaces with Urac 185 adhesive or equal, to minimum $\frac{3}{4}$ " (19 mm) fir-faced, close grain marine-grade plywood applied under high pressure. In accordance with AWI 1600A-G-1, use horizontal grade on all exposed surfaces, vertical grade on semi-exposed surfaces and sealed paint on all concealed surfaces. Reject plastic laminate or plastic backing shall be used to prevent warping, unless otherwise specified. All edges shall be carefully sanded to smooth finish, removing burns, nicks, and cur marks. Plastic laminate joints shall be finished without wavy and unsightly joints. Joints need not be mitered except as specified. Hand sand edges to a slight chamfer.
2. Top sheet shall be placed on and over finished edge. Ease exposed edge to overlap sheet. Use largest sheet possible in order- to minimize seams.
3. Coved backsplashes shall be a minimum of $\frac{1}{4}$ " (6 mm). End splashes may have a square intersection with tabletops unless specified otherwise.
4. Plastic laminated shelves shall be laminated with horizontal grade laminate on the side and vertical grade at all edges.

D. Doors, Hinged:

1. Hinged doors shall be fabricated of $\frac{3}{4}$ " (19 mm) thick marine-grade plywood with hardwood full perimeter edge with plastic laminate on face and self-edging on exposed sides unless indicated otherwise in drawings and details. Door hinges, pulls and catches shall be supplied and detailed. Provide Grass 1200, 176 degree opening concealed casework hinges or equal by Blum or Amerock. Door catches shall be Component Hardware Model M22-2420 for non-magnetic and Model M30-2400, heavy duty, self-aligning for magnetic.
2. Utilize EPCO Model MC 4023.5 or as specified in the Item Specifications.
3. Door locks shall be Component Hardware Model P30 Series; stainless-steel faced; master keyed as specified.

E. Doors, Sliding:

1. Sliding doors shall be fabricated of solid core marine-grade plywood with hardwood edges and constructed similar- to hinged doors. Doors shall be mounted on E-Z Glides track. Doors shall be removable without the use of tools. Rubber stops shall be provided concealed in end stile or mullion.

F. Access Panels: Access panels shall be fabricated of $\frac{3}{4}$ " (19 mm) nominal thick hardwood and shall be fabricated as a door. Each access panel shall be provided with 2 (two) magnetic catches at top and 2 (two) $\frac{3}{16}$ " (5 mm) positioning pins at bottom.

G. Drawers:

1. Drawers shall have dovetail construction, well glued and blocked. Fronts shall be not less than $\frac{3}{4}$ " (19 mm) thick hardwood. Sides and back shall be

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½" (13 mm) thick fabricated of Birch, Maple, or Sycamore except where extension slides are used, in which the side shall be ⅝" (10 mm) thick. Bottom shall be milled into fronts and sides.

2. Drawers shall be provided with suitable stops. Provide pulls as detailed or specified. The inside surfaces of all drawers shall receive one coat of penetrating primer and one coat of glass lacquer.

H. Painted Finishes:

1. Painted finishes shall have exposed surfaces free from defects and blemishes that would show after being finished, regardless of grade specified. All surfaces specified to receive paint or enamel finish shall receive one cross coat of lacquer type undercoat. The undercoat shall be of appreciably different color from that of the finish coat, and of proper ground color with relation to the finish coat. After the undercoat has been thoroughly dried, surfaces shall be sanded smooth, and two coats of enamel shall be applied. Back painting shall be provided for all cabinet and woodwork prior to installation.

I. Interior & Wall Shelves:

1. Interior shelves shall be adjustable with flush routed-in shelf standards. Wall shelves to be fabricated as specified and as per "Standard Detail".

J. Fire Retarding:

1. Where required by code, all required materials are to be treated with fire retardant chemicals to achieve the required flame spreading performance rating. Retardant chemicals must be a type approved by local authorities.

2.6 FILTER EXHAUST HOODS AND/OR WATER WASH VENTILATOR FABRICATION:

- A. 18-gauge (1.3 mm) type 201 or 304 stainless-steel external welded construction, in accordance with the latest edition of N.F.P.A. No.96 and International Mechanical Code, including all applicable appendices. Exposed welds to be ground and polished. Exhaust hoods to be U.L. Listed as available for length specified.
- B. Furnish type of fixture specified. Fixtures to be U.L. listed for cooking equipment exhaust hoods, NSF-approved, and with sealed safety lenses.
- C. Furnish welded stainless-steel formed duct collars at ceiling or wall duct connections. Verify size and location of duct connections required in this contract before fabrication.
- D. Pre-piped liquid chemical or water fire suppressant system, as specified; complying with applicable local and N.F.P.A. regulations. Wet chemical fire suppression systems to comply with UL 300 Standards. Water fire suppression systems to comply with U.L. Category Subject 199E. Each pull station is to be clearly identified with a permanent type label, as to which exhaust hood(s) it is for. Each

exhaust hood is to have a matching permanent-type label, identifying which pull station activates its fire system.

- E. All cooking equipment below exhaust hoods/ventilators, on casters, are to be provided with positive wheel placement systems for the rear casters, similar-to Posi-Set units, in compliance with NFPA-17A 5.6.4 and NFPA-96 12.1.2.3.
- F. Water wash or ultra-violet control panel to be by the same manufacturer as the ventilator, with time clock control for automatic operation. Provide stainless-steel trim strips for recessed control cabinet applications. Provide stainless-steel chase for surface mounted control panel, from top of panel to ceiling, full width and depth of panel.

2.7 REFRIGERATION EQUIPMENT:

- A. General:
 - 1. Furnish either single or multiple compressor units, as specified or recommended by the manufacturer for the sizes and variations between connected evaporator loads as indicated.
 - 2. Furnish units of the capacities indicated, arranged to respond to multiple-evaporator thermostats and defrosting timers. Include coils, receivers, compressors, motors, and motor starters, mounting bases, vibration isolation units, fans, dryers, valves, piping, insulation, gauges, winter control equipment and complete automatic control system.
 - 3. Refrigerant: Pre-charge units with type or types recommended by manufacturer for services indicated, with quick-disconnect type connections only where specified, ready to receive refrigerant piping runs to evaporators and (where remote) to condensers. All refrigerant and associated components to comply with the requirements of the Montreal Protocol Agreement. No CFC or HCFC refrigerants or associated components will be permitted on this Project. HFC refrigerants and components are to be used. Contractor is responsible for coordinating these requirements with manufacturers.
 - 4. Foodservice equipment items included in this Section, with remote refrigerated systems, are to include interconnecting refrigeration lines, sizing, and insulation between components, as per manufacturer's installation instructions, and as determined by this Contractor's Certified Refrigeration Sub-Contractor; and only after a thorough examination of actual site conditions and obstacles which might affect the routing. Routing should be as direct and short as possible and practical. Refer to additional requirements listed in this Section 11 40 00, 1.5 Laws, Ordinances and Standards.
 - 5. The minimum outdoor operating ambient temperature for design of units is -10 degrees Fahrenheit (-23 Centigrade), or lower as applicable for extreme low local conditions. The maximum indoor design temperature for operation of compressor units is 95 degrees Fahrenheit (35 Centigrade). The maximum outdoor ambient design temperature is to be determined by Contractor with prevailing conditions at mounting location of compressor, such as sun

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exposure, limited ventilation, high fences/walls, roof color and materials, local climatic extremes, etc.; but in no case is it to be less than 100 degrees Fahrenheit (37.8 Centigrade).

6. All refrigeration systems with remote condensing units and jobsite installed interconnecting refrigeration lines shall be tested to verify that there are no leaks. Leak testing shall be equal to or better than a professionally recognized 48-hour minimum, pressure holding test. If any leaks are detected, they shall be repaired and another leak test preformed; until there are zero leaks detected. A written report of the type test preformed, and a step-by-step record of the procedure and readings shall be submitted to Contractor for inclusion in the Operations and Maintenance Data Manuals.

B. Components:

1. Coils for fabricated refrigerators to have vinyl plastic coatings, stainless-steel housings; and be installed in such a manner as to be replaceable.
2. Provide guards for all refrigeration/freezer fans, with maximum 1/2" (13 mm) mesh.
3. Remote refrigeration system to be complete with thermostatic expansion valves at the evaporator.
4. Fabricated refrigerated compartments to be fitted with flush dial thermometers, with chrome plated bezels. Thermometers to be adjustable and shall be calibrated after installation. Thermometers to have an accuracy of ± 2 degrees Fahrenheit (1 degree Centigrade).
5. Hardware:
 - a. Refrigerator hardware for fabricated refrigerator compartments to be heavy-duty components.
 - b. Self-closing hinges.
 - c. Latches to be magnetic edge mount type, unless specified or detailed otherwise.
6. Doors and drawers for walk-in coolers/freezers, and reach-in refrigerated compartments, both fabricated and standard, to be fitted with cylinder locking type latches, and provided with master keys.
7. Provide and install shut-off valves and service port for each compressor, manifold or header, and refrigerated fixture for multiplex and parallel installations to enable service personnel to service one (1) fixture while other fixture(s) connected to the same compressor can continue to operate. Isolation valves for individual fixtures based upon the sizes of the individual pieces.
8. Drawers for refrigerated fabricated compartments shall be complete with heated surround at closing perimeter.

C. Cold Pans: Ice pans, refrigerated pans and cabinets to be provided with breaker strips, where adjoining top or cabinet face materials, to prevent transfer of cold.

D. All mechanically cooled custom fabricated or standard buy-out refrigerators with openings in the top for cooling pans, and/or all built-in or drop-in mechanically

cooled cold pans are to comply with and be listed by NSF Standard #7. Contractor is to verify that the specified unit complies with this requirement.

E. Ventilation of Refrigerated Equipment:

1. Adequate ventilation to be provided for custom fabricated equipment with integral refrigeration condensing units, both built-in and drop-in. If flow-through ventilation cannot be provided, provide flow direction partitions and an additional squirrel fan(s) capable of cooling the condensing unit.
2. If, in the opinion of the Contractor, additional room ventilation is required to ensure correct operating temperatures of standard buy-out, custom fabricated, or remote refrigeration condensing units, or compressor rack assemblies, they are to so state in a letter to the Architect, for evaluation and decision.

2.8 REMOTE REFRIGERATION SYSTEMS

A. All remote refrigeration systems shall be furnished and installed by one contractor, unless otherwise specified. Provide all components necessary for a complete and operable system. System to be fully capable of satisfying the refrigeration requirements for each fixture as defined by the manufacturer of each fixture.

B. Compressor and Condensing Units:

1. Units shall be factory assemblies complete with hermetic units below 1 HP, semi-hermetic units 1 HP and larger, air or water-cooled condenser, depending upon building conditions and specifications, high-low pressure controls, suction accumulator on low temperature system, sight glass, liquid line dryer, suction and discharge service valves, liquid receiver, and electric control panel. The electrical control panel shall be furnished with magnetic motor starter, defrost timer clock, and contractors in accordance with "Refrigeration Schedule". Compressor capacities shall be based on Air Conditioning and Refrigeration Institute (A.R.I) Standards. The refrigerant for medium and low temperature fixtures to be CFC free and conform to the Montreal Protocol Agreement.
2. Capacities shall be based on the following:
 - a. Compartment temperature and evaporating temperature greater than 32°F (0°C) 18 to 20 hours operations.
 - b. Compartment temperature greater than 32°F (0°C) and evaporating temperature less than 32°F (0°C) 16 hours operation.
 - c. Compartment temperature and evaporating temperature less than 32°F (0°C) 18 hours operation.
3. Condensing units shall be mounted on a steel base to affect a quiet operation. All rotating parts to be carefully balanced for minimum vibration and lubricated with forced or splash oil system. Receiver shall be sized for a complete pump down of the system and shall be shell type with fusible plug.
4. Compressor units to be provided with suction and discharge back setting type service valves and standard machinery finish.
5. Motors shall be single speed, maximum 1750 R.P.M. compound wound

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ball bearings or sleeve bearing. Double squirrel cage motors with high starting torque set and low starting current to be used in a 3-phase application.

6. All machines to be equipped with quick acting type high-low pressure control switches having adjustable range and differential and high-pressure cut-out. Cut-out to be automatic reset type.
7. For air-cooled units the condenser shall be a standard manufactured part of the equipment. Condensing temperatures shall be based upon (100°F 38°C) ambient air.
8. Other components and accessories, such as suction filter and crank case heater shall be furnished when specified in the itemized specifications.

C. Motor Starters-Contactors:

1. All single-phase motors shall be provided with mounted and internally wired contactors, except where pre-wired units are furnished without contactors. Single phase compressors shall be provided with built-in thermal and electrical overload protection.
2. All three-phase motors shall be provided with magnetic type starters with quick trip overload elements matched for motor amperage except where overload protection is built into the compressor motor and the manufacturer supplies a contactor instead of a starter. Overload heater element shall be sized according to manufacturer's recommendations. Compressor motor starters shall be definite purpose starters with manual reset.
3. Starters shall be installed upon surfaces free from excessive vibrations.
4. Where starters are required for installation in a motor control center, make and model of control center shall be verified, and starters provided to match.

D. Oil Separator

1. Provide oil separators, except when Compressor Manufacturer requires otherwise, 34°F, (1°C) and below and install as near as possible to the compressor. The return line shall be connected to the top of the crankcase above the oil level. Where compressor does not have connection for oil return line from separator, connect to a tee in the suction line adjacent to the compressor. Exposed oil return line to be provided with shut-off valve of the packless stem type.

E. Compressor Rack Systems:

1. Racks shall be of the number of tiers and quantity to accommodate the number of condensing units specified for each rack assembly and allow for service clearance and ventilation. Review and confirm access into building or housing requirements to roof top locations.
2. Racks shall be fabricated with structural steel of size and quantity to properly support the equipment to be installed on the rack. In special

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applications where building access is limited, construct rack framing with Dexion of Unistrut material.

3. Racks shall be all welded construction with welds ground smooth.
4. After completion of fabrication the complete rack shall be cleaned, primed and painted with top quality oil-base enamel.
5. Each rack shall be equipped with a pre-wired receptacle.
6. Racks shall be pre-wired to a circuit breaker panel and pre-plumbed to a header (when specified water cooled) requiring a single point electrical and plumbing connection.
7. Racks shall have UL or equivalent approval.
8. Special Conditions: For custom built racks for individual condensing units provide Dixon Angle Iron.

F. Coils and Cooling Units:

1. Units shall be direct expansion type of size and design to effect required temperature, humidity and to suit application intent.
2. Units shall be hung from the ceiling with 1/2" (13 mm) nylon rods with plated steel nuts and lock washers. Rods shall extend through ceiling to bracing adequate for the suspended weight. Bracing shall be furnished as required; penetrations shall be sealed and trimmed with escutcheon plates.
3. Units shall be installed tight to ceiling. All installations adjacent to walls shall be set out a minimum distance conforming to manufacturer's directions, to ensure proper air circulation and performance.
4. Units with fan or blower and motor shall have thermal overload protection and be wired as indicated in "Refrigeration Schedule".
5. Defrost cycle shall be based on the following:
 - a. Coils for 32°F (0°C) and lower shall have an electric defrost controlled by a time clock mounted on the compressor rack or at evaporators locations inter-wired by Division 26 - Electrical.
 - b. Coils for 33°F (0.6°C) and 34°F (1°C) shall have an air defrost controlled by a time clock mounted on the compressor rack or at evaporators locations inter-wired by Division 26 - Electrical.
 - c. Coils for temperature above 34°F (1°C) shall have an air defrost in the off cycle controlled by proper sizing of the coil and the compressor.
6. Location of coils shall be coordinated with shelving and floor sink locations.
7. All coils for fabricated refrigerators and/or freezers shall be installed for accessibility and replacement.

G. Penetration Sleeves and Plates:

1. Service line penetrations of insulation to accommodate electrical conduit, refrigerant and drain lines shall be limited to a minimum with service stubbed through insulation or locations predetermined by respective divisions.
2. Where service lines penetrate insulated walls, the opening shall be packed with caulking, before trimming with escutcheon plate.
3. Where service lines penetrate building walls outside of foodservice areas,

the opening shall be packed with "Perma-Gum" and foam caulking.

4. All exposed ends of sleeves, both inside and outside of compartments, are to be trimmed with 24-gauge stainless-steel escutcheon plates, furnished as blanks in which respective work divisions shall cut required line holes and install.

H. Refrigerant Piping:

1. Copper tubing for refrigerant piping shall conform to ASTM standard specifications, serial designation B-88. All piping shall be type "L" ACR hard copper or cleaned and sealed soft type "L" tubing, dry seal or equal as indicated. Forged or wrought copper fitting with sweat or soldered joints shall be used.
2. Tubing shall be cut only with a tube cutter and sized with a sizing tool.
3. Piping shall be exposed to view as required by the standard safety code for mechanical refrigeration.
4. The liquid suction lines from condensing units to coil shall be sized and run as shown on the "Refrigeration Schedule" and Refrigeration Drawings.
5. Piping run within cold storage rooms shall be finished with aluminum paint.
6. For exposed areas, accessible furred ceiling spaces and in walls or excavated trench type installations, hard copper tubing shall be used. Exposed tubing shall be run in a manner to preclude damage by activities in the area; or shall be protected by conduit, furnished, and installed as part of this contract. Conduit shall have water evacuated and both ends completely sealed.
7. For piping run in conduit through inaccessible areas, such as under slab on grade, continuous one-piece soft copper tubing shall be used with no joints. In lieu of large piping in conduit, especially vertical runs, random lines may be used; carefully fabricated and assembled to ensure equal pressure drop.
8. Ends of lines shall be capped to prevent contamination and opened only at time of final connection.
9. Suction lines shall be sized for a maximum pressure drop from evaporator to compressor 2 lbs. (0.9 kg.) for high and medium temperature systems, and of 1 lb. (0.45 kg.) for low temperature systems and shall allow gas velocities of not less than 750 FPM (3.8 M/sec.) in horizontal runs and 1500 FPM (97.6 M/sec.) in vertical risers. Liquid lines shall be sized for a maximum pressure drop of 3 lbs. (1.36 kg.) from receiver to evaporator.
10. Tubing runs shall be graded or pitched to prevent trapping of oil. Suction lines shall pitch 1/2"/10"-0" (13 mm/2.54 m) minimum.

I. Joints and Connections:

1. Fittings shall be long radius wrought copper only as manufactured by Mueller Brass Company or equal.
2. Vertically run suction lines shall have one piece of manufactured oil "P" traps. Line to be sized for proper velocity for oil return to compressor(s).
3. 1/8" NPT by 1/4 fl. half union for all suction and discharge service valves

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with 1/4 fl. cap.

4. Reduction in piping size shall be made with a manufactured reducer coupling.
5. Flare nuts shall be short forged or frost-proof.
6. All surfaces to be joined must be prepared and cleaned. When soldering stop or solenoid valves, wrap valves with moist fabric to absorb excessive heat. Stop valves shall be partly open. When soldering expansion valves or pressure regulating valves, remove power assembly, if necessary, to prevent damage by excessive heat.
7. Copper joints shall be made with Handy & Harmon "Sil-Fos" brazing alloy, "Phoson 15", "Silvaloy 15" or equal; melting point of 1185-1350°F; (640°C. - 732°C.) Silver content not less than 15%.
8. Copper to brass joints shall be made with Handy & Harmon "Easy Flo 45" brazing alloy "Silvaloy 45", "Mueller 122" or equal; melting point of 1125-1145°F, (607°-618°C.) silver content not less than 45%.

J. Hangers and Supports:

1. For all piping not run within conduit, provide adjustable hangers, anchors or straps as required. Hanger spacing shall not exceed 8'-0".
2. Insulated copper piping shall be provided with approved type sleeves at hanger points.
3. All insulated copper piping shall be isolated from supports by means of felt wrapping or with "Trisolater" by Semco or approved equal.
4. Vertical piping shall be supported at intervals with spring type hangers or a substantial pipe at case of the pipe. All horizontal pipe runs connected to vertical risers must be adequately supported.
5. For suspended conduit, support shall be by means of hanger permitting screw adjustments. Sufficient hangers shall be used to provide support, allow expansion, and limit vibration.

K. Piping Sleeves:

1. Coordinate sleeves provided by the General Contractor through walls which allow for fully insulated lines. Extend sleeves entirely through wall and dress each end with a chromium plated wall plate neatly fitted against the wall, securely fastened and sealed in place. All sleeves through wall shall be of standard weight steel pipe.
2. Piping lines and sleeves at wall or floor penetrations shall be caulked and made vermin-proof at all locations.

L. Piping Insulation:

1. Suction lines run in conduit shall be insulated according to ambient and humidity conditions to prevent condensation and freezing.
2. Refrigeration suction lines outside of refrigerated compartments, not run in conduit, shall be insulated back to compressors with Armstrong Armaflex AP foamed plastic insulation or as determined by code. Thickness of material shall suit service, ambient and humidity conditions, to prevent condensation, minimum thickness 1/2" (15 mm.).

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3. Freezer Storage Room drain lines should not be extended through adjacent cooler compartments if at-all possible. All such lines shall be insulated with 1/2" (15 mm) minimum thickness of Armstrong Armaflex AP foamed plastic insulation to prevent condensation. Carefully seal end of insulation tight against freezer wall surface.
4. Piping for cooling water services or refrigerant piping exposed to freezing ambient temperatures shall be insulated with 1/2" (15 mm) minimum thickness of Armstrong Armaflex AP foamed plastic insulation. Paint exterior installation with Armaflex paint.
5. Thickness of material shall suit service, ambient and humidity conditions to prevent condensation.
6. Joints shall be sealed with Armstrong 520 adhesive. Insulation shall be continuous through clamps. Provide additional insulation where suction lines must be run within 12" (304 mm) or less of water or underground waste lines.
7. Exterior-run piping shall be insulated as per above and covered with stainless-steel channels secured to structure, sealed to be weather-proof.

M. Heat Interchangers:

All blower controls, unit coolers, plate type evaporators and other evaporators where specified, are to be provided with heat interchangers, with a capacity to match the condensing unit.

N. Temperature Control:

1. Temperature control of cold storage rooms shall be by line voltage thermostats operating liquid line solenoids.
2. Temperature control for remote normal temperature refrigerator shall be by low pressure switch setting.
3. Temperature in each cold storage room compartment shall be controlled by electric thermostat, Ranco No. 010-1408, located within compartment and sensing element positioned to avoid fan discharge air stream.
4. Contractor to coordinate any additional specified temperature control/monitoring/alarm system within this document set including assisting with coordination of home-run control wiring, wireless assembly coordination and HACCP requirements in terms of reporting.

O. Valves and Accessories:

1. All valves and controls shall be standard weight and suitable for service purpose intended, and subject to approval by the Designer.
2. Provide shut-off valves and service port for each refrigerated fixture for multiplex installations to enable service personnel to service one (1) fixture while other fixture(s) connected to the same compressor can continue to operate.
3. Each system shall include condensing unit with standard valving, refrigerant piping, refrigerant, evaporator(s), liquid and suction line

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isolation valves within 5'-0" (1500 mm) of evaporators, thermostatic expansion valve for evaporator, heat exchanger, filter-dryer, liquid line solenoids for Cold Storage Rooms and liquid indicator.

4. Vibration eliminators on compressor suction and discharge lines, size same as piping, as manufactured by Anaconda.
5. Refrigerant shut-off valves shall be as manufactured by Henry or Superior Valve Company. Valves shall be placed and in liquid line for each condensing unit and in each liquid line to each evaporator.
6. Expansion valves shall be Sporlan, or approved equal, furnished, and installed in the liquid line at the evaporator, unless provided with manufactured equipment. External equalizer expansion valves shall be provided for coils fitted with refrigerant distributor.
7. A Sporlan, or approved equal, drier shall be provided at the compressor. Up to 3HP shall be a Catch-All series; larger than 3HP shall be angle replaceable cartridge series or approved equal.
8. Each liquid line sight glass shall be Sporlan "See All" moisture and liquid indicator and shall be full line size or approved equal.
9. Solenoid valves shall be Sporlan, or approved equal, line voltage, manual lift stem type, to operate at maximum of 2 lbs. (0.9kg.) pressure drop across the valve. Valves shall be full line size, using silver solder connection as applicable. A liquid line solenoid, normally closed, shall be used with temperature controller for each Cold Storage Room compartment coil on a system.
10. Include a suction line filter with access valve adjacent to compressor. Filter shall be a Superior "F" Series or equal.
11. EPR, CTR, and/or CDA valves shall be Alco, or Sporlan, or approved equal.
12. Suction accumulators shall be Refrigeration Research 3700 series or Virginia VA series, or approved equal.
13. Discharge line mufflers shall be Refrigeration Research M-10 and M-15 or AC and RSS- 6300 series or approved equal.
14. Time clocks shall be Paragon or approved equal.

P. Drain Lines:

1. Type "L" copper coil drain lines extended to exterior of refrigerated compartments over floor sinks (drain) with "S" traps at termination ends.
2. Provide clean out "T" and cap at each change of direction in the lines. Provide individual drain lines for each coil unless otherwise specified. Drain lines shall be run tight to refrigeration compartment walls with minimum pitch of 2" per foot.
3. Drain lines inside low temperature compartments shall be equipped with drain-line heaters provided by and wired by electrical division. Freezer Storage Room drain lines should not be extended through adjacent cooler compartments if at all-possible. (Drain line in low temp compartment to be insulated with Armaflex ½" (13 mm) – insulation and wall fastening by the foodservice equipment contractor).
4. Drain lines on the exterior of refrigerated compartment shall be painted

with chrome tone paint and shall be trapped to disallow ambient air infiltration into refrigerated cavity.

Q. Refrigerant/Compressor Oil Reclaim:

1. For existing refrigeration systems which may be reused, abandoned or where site conditions warrant, the system(s) refrigerant, oil and/or other components shall be reclaimed and contained by certified personnel in conformance to Refrigerants and Hazardous Waste criterion as specified by the Environmental Protection Agency and/or Montreal Protocol Guidelines & Requirements.

2.9 MISCELLANEOUS MATERIALS AND FABRICATION:

- A. Nameplates: Whenever possible, locate nameplates and labels on manufactured items, in accessible position, but not within customer's normal view. Do not apply name plates or labels on custom fabricated work, except as required for compliance with governing regulations, insurance requirements, or operator performance.
- B. Manufactured Equipment Items: Furnish items as scheduled or herein specified. Verify dimensions, spaces, rough-in and service requirements, and electrical characteristics, before ordering. Provide trim, accessories and miscellaneous items for complete installation.
- C. Insert Pans:
 1. General: Cut-outs, openings, drawers, or equipment specified or detailed to hold stainless-steel insert pans to be provided with a full complement of pans as follows:
 - a. One (1) stainless-steel, 20-gauge (1 mm) minimum, solid insert pan – in us pan size or gastronorm configuration as specified for each space, sized per plans, details, or specifications.
 - b. Where pan sizes are not indicated in plans, details, or specifications, provide one full-size pan for each opening.
 - c. Provide maximum depth pan to suit application and space.
 2. Provide 18-gauge (1.3 mm) NSF- approved removable stainless-steel adapter bars where applicable.
 3. All cut-outs and openings, or equipment specified or detailed to hold stainless-steel insert pans, shall be provided with a hinged stainless-steel removable night cover.
- D. Tray Slides: Before fabrication of counters with tray slides, verify:
 1. Size and shape of tray with Owner/Operator prior to fabrication. Edge of tray should not overhang outer support/slider by more than 2" (50 mm). If edge of tray exceeds this dimension, notify Architect, in writing, for evaluation and adjustment, if necessary.
 2. Configuration of corners, turns, and shape of tray slides for proper support and safe guidance of trays.

3. Tray slide to be capable of supporting 200 pounds per linear foot (298 kgs/meter), live load.
- E. Self-leveling dispensers: Verify type, make dimensions and weight of ware with Owner/Operator; and submit to the dispenser manufacturer, for proper sizing and calibration of dispensers.
- F. Carbon dioxide (CO²) equipment: Where equipment requires connection with compressed CO² cylinder for operation, provide 2-cylinder manifold and control system (integral with equipment) with proper connectors for Department of Transportation (DOT) approved type cylinders, complete with cylinder safety devices and supports. Applicable to projects with CO₂ equipment included in Contractor's specified equipment.
- G. Reasonable quietness of operation of equipment is a requirement, and Contractor will be required to replace or repair any equipment producing out-of-the-ordinary intolerable noise. This also includes providing and installing bumpers and gaskets for doors and drawers on fabricated and standard manufactured items and sound insulation where feasible.
- H. Gas pressure regulator: All gas fired equipment included with this Section is to be provided with a gas pressure regulating valve with a built-in vent limiting device sized per WC pressure rating of this project. Contractor is responsible for coordinating this requirement with their manufacturers and suppliers.

PART 3 – EXECUTION

3.1 SUPERVISION:

- A. A competent supervisor, representing the Contractor, is to be present at-all times during progress of the Contractor's work.
- B. Contractor is responsible for coordinating with all applicable Design Team members, Key Ownership Stakeholders Assigned, General Contractor, other Contractors and/or Sub-Contractors and Trades involved in this Project and associated with any items or work provided under this Section; as required for the successful provision, installation, completion, and functioning of these items and/or work, and the Project in general. This is to include, but not be limited to, exchange of shop drawings, details, and manufacturer's information, supplying templates or actual components to be installed in or on items provided by other Sections, for coordination; and coordinating with and between their own internal staff, sub-contractors, trades, manufacturers, fabricators, and installers, for compliance with the Contract Documents.
- C. Contractor responsible for obtaining any documents referenced in this Section and on any associated drawings, which contain information relative to the performance of this Contract; and disseminating and coordinating the pertinent information

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contained in them, with the appropriate sub-contractors, manufacturers, fabricators, and/or installers.

- D. Contractor is to take every precaution against injuries to persons or damage to property.
- E. Contractor is to store his apparatus, materials, supplies and equipment in an orderly fashion at the site of the work so it will not unduly interfere with the progress of his work or the work of any other contractors.

3.2 SITE EXAMINATION:

- A. Verify site conditions under the provisions of the General Conditions, Supplementary Conditions, and applicable provisions of Division 1 Sections. Notify the Architect, in writing, of unsatisfactory conditions for proper installation of foodservice equipment.
- B. Verify wall, column, door, window, and ceiling locations and dimensions. Fabrication and installation should not proceed until dimensions and conditions have been verified and coordinated with fabrication details.
- C. Verify that wall reinforcement or backing has been provided and is correct for wall supported equipment. Coordinate placement dimensions with wall construction Section.
- D. Verify that ventilation ducts are of the correct characteristics, and in the required locations.
- E. Verify that utilities are available, of the correct characteristics, and in the required locations.

3.3 DELIVERY AND INSTALLATION:

- A. Delivery:
 - 1. The equipment shall be delivered and installed on schedule. Coordinate all work with the General Contractor and other divisions as required.
 - 2. Deliver materials (except bulk materials) in manufacturer's containers, fully identified with manufacturer's name, trade name, type, class, grade, size, color, item number, area, etc.
 - 3. Contractor is responsible for receiving and warehousing equipment and fixtures, until ready for installation. Store materials, equipment, and fixtures in sealed containers, where possible. Store off the ground and under cover, protected from damage.
 - 4. Contractor to verify and coordinate conditions at the building site, particularly door and/or wall openings, and passages, to assure access for all equipment. Pieces too bulky for existing facilities are to be hoisted or otherwise handled with apparatus as required.
 - 5. Extra charges resulting from special handling or shipment to be paid by

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the Kitchen Equipment Contractor if insufficient time was allowed in placing factory orders to ensure normal shipment.

- B. The work to be accomplished so as not to delay the project construction schedule, interfere, or conflict with the work being performed by other contractors. Work to be coordinated and integrated to prevent conflict of work necessitating changes to work already completed. Sequence installation and erection to ensure correct mechanical and electrical utility connections are achieved.
- C. Verify all field dimensions before fabrication.
- D. Install items in accordance with manufacturer's instructions.
- E. Set each item of non-mobile and non-portable equipment securely in place, leveled and adjusted to correct height. Anchor to supporting substrate where indicated, and where required for sustained operation and use without shifting or dislocation. Conceal anchorages wherever possible. Adjust counter tops and other work surfaces to a level tolerance of 1/16" (1.6 mm) (maximum offset, and plus or minus on dimension, and maximum variation in 24" (610 mm) run from level or indicated slope). Provide anchors, supports, bracing, clips, attachments, etc., as required to comply with the local seismic restraint requirements. The Guidelines for Seismic Restraint of Kitchen Equipment, as prepared for the Sheet Metal Industry Fund of Los Angeles and endorsed by S.M.A.C.N.A., is to be followed.
- F. Complete field assembly joints in the work (joints which cannot be completed in the shop) by welding, bolting-and-gasketing, or similar methods as indicated and specified. Grind welds smooth and restore finish. Set or trim flush, except for "T" gaskets as indicated. Field joints shall not be visible to the untrained eye.
- G. Provide closure plates and strips where required, with joints coordinated with units of equipment.
- H. Provide sealants and gaskets all around equipment to wall, ceiling, floors, masonry pads, and adjoining units not portable and with enclosed bodies to make joints airtight, waterproof, vermin-proof, and sanitary for cleaning purposes. Space between all equipment to wall, ceiling, floors, masonry pads, and adjoining units not portable and with enclosed bodies to be completely sealed against entrance of food particles or vermin by means of trim strips, welding, soldering or mastic. Mastic to be General Electric Silicone Construction Sealant Series SE1200 or equal in appropriate color.
- I. Joints up to 3/8" (9.5 mm) wide, to be stuffed with backer rod, to shape sealant bead properly, at 1/4" (6 mm) depth.
- J. At internal corner joints, apply sealant or gaskets to form a sanitary cove, of not less than 3/8" (9.5 mm) radius.

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- K. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of materials at joint.
- L. Provide sealant filled or gasketed joints up to 3/8" (9.5 mm) joint width. Wider than 3/8" (9.5 mm), provide matching metal closure strips, with sealant application each side of strips. Anchor gaskets mechanically, or with adhesives to prevent displacement.
- M. Treat enclosed spaces, inaccessible after equipment installation, by covering horizontal surfaces with powdered borax at a rate of 4 ounces per square foot (1.2 kg/m²).
- N. Insulate to prevent electrolysis between dissimilar metals.
- O. Cut and drill components for service receptacles, fixtures, piping, conduit, fittings, etc. as required. Grind and polish penetrations to safe tolerance. Work to include welded sleeves, collars, ferrules or escutcheons.
- P. Verify and coordinate the mounting heights of all wall shelves and equipment, with equipment located below them, for proper clearances.
- Q. Walk-In Refrigerator/Freezers:
 - 1. The cold storage rooms shall be delivered and installed on schedule by factory supervised and approved installers. Coordinate the work with the General Contractor and other trades as necessary.
 - 2. Provide the necessary job site coordination with the various trades to ensure job site conditions will meet the requirements of the cold storage rooms.
 - 3. During curing and cleaning of the wearing floors inside the cold storage rooms, the cold storage room doors shall be left open and the rooms well ventilated to prevent damage to the interior. "Keep Out" signs to be posted at each open door.
 - 4. After the installation of the cold storage rooms and prior to the installation of the wearing floor has cured, the cold storage room doors are to be closed and locked.
- R. Coordinate with the Plumbing and Electrical Divisions and provide penetrations in foodservice equipment for plumbing and electrical service to and through the fixtures, as required. This includes welded sleeves, collars, ferrules, or escutcheons. These services are to be located so that they do not interfere with intended use and/or servicing of the fixture.
- S. All equipment provided by this Section, that requires light bulb(s), are to be provided with heavy-duty, energy efficient, extra long-life bulbs with a minimum life expectancy of 5000 hours, and as required by the local Jurisdictions. All light bulbs in and/or above foodservice equipment and/or areas are to be coated or provided with shields in compliance with local health codes.

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- T. All equipment provided by this Section, shall include any-and-all parts, components, options, accessories, etc. necessary to provide a completely functional item for its intended use under normal conditions; and if appropriate, after the final utility connections are completed by other Divisions. This shall generally apply to equipment such as soda systems, beer systems, and remote refrigeration systems, any type of remote system or equipment, or ice machines; but shall also apply to any equipment provided by this Section.

3.4 COUNTERTOP INSTALLATION:

- A. General: Install countertops, except for vanities, over plywood sub-tops with a full spread of water-cleanable epoxy adhesive.
- B. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
1. Tops:
- a. Flat and true to within 1/8" (3 mm) of a flat surface over a 10' length.
- b. Allow a minimum of 1/16" (1.6mm) to a maximum of 1/8" (3mm) clearance between surface and each wall.
- C. Fit countertops around projections and to adjacent construction. Smooth and clean field cut edges. Ensure that trim will completely cover cut edges.
- D. Bond seams with stone seam adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to seams to prevent adhesive smears. Use clamps to ensure countertop units are properly aligned and seams are minimum width.
- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts while cutting to prevent damage.
- F. Install backsplash and end splash by adhering to wall with water-cleanable epoxy adhesive.
- G. Leave 1/16-inch (1.6mm) gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.
- H. Heat isolation for hot food wells, heated deck and other drop-in heated equipment.
1. Three (3) layers of Nomex insulation held in place with aluminum tape.
2. 16-gauge stainless-steel collar.
3. Heat resistant, food safe silicone caulking.
4. Provide a 1/8" (3 mm) minimum space between the heat source and the insulation.
- I. Apply sealant to seams and to gap between countertops and splashes; comply with Section 07 92 00 (07920) "Joint Sealants."

J. Countertop Adjusting and Cleaning:

1. Remove and replace or repair stonework of the following description:
 - a. Broken, chipped, stained, or otherwise damaged stones. Broken, chipped, stained, or otherwise damaged stone may be repaired, providing the methods and results are acceptable to Owner's Representative.
 - b. Defective joints.
 - c. Stones and joints not matching approved samples.
 - d. Stonework not complying with other requirements indicated.
2. Replace in manner that results in stonework matching approved samples and field-constructed mock-ups, complying with other requirements, and showing no evidence of replacement.
3. Clean stone countertops not less than six days after completion of work, using clean water and stiff and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage the stone.

K. Countertop Sealer Application:

1. All surfaces must be clean and free from all loose grit and debris, satins, dirt, and wax coatings. Surfaces shall remain dry for a minimum of 24 hours before the application of sealer and remain dry for 24 hours after the application of sealer.
2. Floor surface temperature must be above 50° F. and below 90° F.
3. Test on a small area before using to determine if the product is acceptable with type of stone.
4. Two (2) uniform coatings of sealer shall be applied before or after installation of stone materials. If prior to installation, adequate documentation shall be included with the material confirming it has been sealed. If after installation, install in strict accordance with Sealer manufacturer's recommendations.

3.5 PROTECTION OF WORK:

- A. Use all means reasonable to protect the materials of this Section against theft and damage before, during, and after installation; and to protect the associated work and materials of the other trades.
- B. Fabricated fixtures: cardboard, fiberboard or plywood taped to tops and exposed body panels/components.
- C. Manufactured Equipment: cardboard, fiberboard or plywood taped as required by equipment shape and installation-access requirements.
- D. Prohibited use of equipment includes tool and materials storage, workbench, scaffolding and stacking of construction materials.

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- E. Damaged Equipment: immediately document and submit to Owner with Contractor's recommendation of action for repair or replacement and its impact on the Project Schedule and Contract Amount.
- F. Pre-fabricated walk-in coolers/freezers are not to be used as general storage; and should be locked before leaving the site daily. Damage and theft resulting from failure to secure units will be repaired or replaced at Contractor's expense.

3.6 ADJUSTING:

- A. Equipment to be tested for leaks, poor connections, inadequate or faulty performance.
 - 1. Thermostatically controlled equipment and equipment with automatic features shall be operated for 14 days to prove controls are functioning as intended. Walk-in refrigerators and freezers shall be turned on and ran for a minimum of fourteen days.
- B. Refrigeration equipment to run a minimum of three days duration before acceptance.
- C. Lubricate and adjust drawer slides, hinges, casters.
- D. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.
- E. Clean or replace faucet aerators, line strainers.
- F. Repair, adjust or replace equipment, which is found to be defective in its operation, including units which are below capacity or operating with excessive noise or vibration.

3.7 CLEANING, RESTORING AND REPAIRING:

- A. After completion of installation, and completion of other major work in foodservice areas, remove protective coverings and clean foodservice equipment, internally and externally. Repair all damage as a result-of this installation.
- B. Restore exposed and semi-exposed finishes removing abrasions and other damages; polish exposed metal surfaces and touch-up painted surfaces. Replace work, which cannot be successfully restored.
- C. Polish glass, plastic, hardware and accessories, fixtures, and fittings.
- D. Wash and clean equipment and leave in a condition ready for the Owner to sanitize and use.

3.8 TESTING:

- A. Delay the start-up of equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.
- B. Contractor, with assistance from a factory-certified representative from the exhaust hood manufacturer, shall conduct an exhaust hood performance test for each exhaust hood in the Contractor's scope of work at the conclusion-of the project when all hoods and related cooking equipment are in operation. Contractor shall have manufacturer's factory authorized representative test and measure exhaust airflow rates, dampers, switches, demand control ventilation, and sequence of operation, with all appliances at operating temperatures. Contractor shall furnish a written report within ten (10) working days of substantial completion and acceptance of the project by the Owner, indicating the design requirements for each hood and the actual operating parameters as tested and measured.
- C. Refrigeration Piping Testing:
 - 1. Each system shall be pressure tested for leaks. Tests for to be on the high side and on the low side. All valves shall be fully open during last test.
 - 2. Tests are to be accomplished as follows:
 - a. Charge the systems with refrigerant through the port of liquid shut-off valves of the receivers to a pressure of 10 to 20 psi
 - b. Add dry nitrogen, the supply of which shall be equipped with a pressure regulating valve to provide the specified pressure.
 - c. Carefully test all joints for leaks using either a Halide torch or an electronic Halogen leak detector.
 - 3. Precautions to be taken to disconnect the low-pressure controls for protection of the bellows during testing.
 - 4. Refrigeration System Evacuation:
 - a. Evacuation shall be with a vacuum pump with an indicating gauge registering pressure in microns. Pump shall be connected to the system with a 5/8" (15 mm) O.D. line or larger.
 - b. Evacuate both high and low sides to 500 microns. Break the vacuum with refrigerant to 0 psi evacuate high and low sides to 100 microns; and then break vacuum to 0 psi. with the refrigerant to be used in the system.

3.9 START-UP AND INSTRUCTIONS:

- A. Make-arrangements for demonstration of foodservice equipment operation and maintenance, in advance with the Owner/Operator.
- B. Demonstrate foodservice equipment, to familiarize the Owner and the Operator on operation and maintenance procedures, including periodic preventative maintenance measures required. Include an explanation of service requirements and simple on-site service procedures, as well as information concerning the name, address and telephone number of qualified local source of service. The individual(s) performing

the demonstration are to be knowledgeable of operating and service aspects of the equipment.

- C. Provide a written report of the demonstration, to the Owner, outlining the equipment demonstrated and malfunctions or deficiencies noted. Identify individuals present at demonstration.
- D. Final Cleaning: After testing and start-up, clean the foodservice equipment, and leave in a condition ready for the Owner to sanitize and use.
- E. All keys for all locks provided with equipment provided under this Section, are to be gathered up, individually tagged with the equipment they belong to, put into a single box, and handed over to the Owner's authorized representative. A list of the keys and their associated equipment Item numbers is to be provided with the O&M Manuals, along with a copy of the list, signed by the Owner's representative, acknowledging receipt of the keys.

3.10 CLEAR AWAY

- A. Throughout the progress of their work, Contractor is to keep the working area free from debris and remove rubbish from premises resulting from work being done by them. At the completion of their work, Contractor is to leave the premises in a clean and finished condition.

3.11 EXISTING EQUIPMENT TO BE USED AFTER COMPLETION OF CONSTRUCTION: *(Applicable only to projects with existing equipment to be used after completion of construction.)*

- A. Within ten working days of award of contract Contractor is responsible for identifying and recording by means of a spreadsheet with accompanying digital photography and heat-resistant tagging of all existing to remain or to be replaced in previous location or relocated equipment that will be used after completion of construction utilizing item numbers from received contract documents. If such equipment has been removed and relocated, contractor is still responsible for this identification and logging process. Contractor shall verify and coordinate specific equipment with these plans and specifications and verify same with the Owner, Architect and Foodservice Design Consultant. This includes items existing to remain or to be relocated, or to be removed, stored or refurbished and set back in place and used after completion of construction - and the associated work necessary - at the time of the signing of the Contract for the Foodservice Equipment section - and does not include any items added, changed, or damaged (by other than the Contractor) after the signing; except to the extent of work that would have been included with the original existing items. Contractor shall then remove such equipment to the agreed-upon storage location previously assigned and verified by the GC and Owner. Existing equipment to be re-placed in previous location or re-located and used after completion of construction shall be identified in both storage during construction location and intended final placement location on heat-resistant tag secured to unit by Contractor. Contractor shall also define critical clearances and

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utilities within this time frame including the testing of actual electrical, plumbing, mechanical values of any equipment without service or factory-applied serial numbered plates. When equipment is removed and re-located or placed back in original location, contractor is responsible for ensuring manufacturer-recommended clearances to walls and adjacent equipment, structural support needs, pour paths, correct MEP rough-in connection values and any applicable fire suppression and exhaust system protection.

- B. Remove from existing locations, clean, and renovate/refurbish as noted below, store and re-install existing equipment to be used after completion of construction, in the new locations as shown on plans ready for utility connections, as appropriate. Existing equipment to be used after completion of construction, with utility connections, to be removed after disconnection as noted in paragraph J, below.
- C. Perform work in cooperation with Owner, so that normal functioning of services is minimally interrupted. Coordinate all removal and replacement scheduling with the Construction Scheduling Manager (or similar responsible party), to ensure adequate time to complete the necessary work. If adequate time to properly relocate and reset the existing items and complete all cleaning and repair will not be available, due to continuing use of the existing items, or the allotted construction time; contact the Owner and obtain a written agreement as to what work is to be deleted or delayed, such as cleaning, repainting, or repairs.
- D. All surface dirt, grease, oil, food residues, ingredients, extraneous matter and other soiling materials is to be removed in order to obtain minimum acceptable sanitation and foodservice standards. Thorough final rinsing of all cleaning agents to be at a minimum temperature of 180 degrees Fahrenheit (82.2 Centigrade) where possible without damage to equipment or controls. Otherwise, use USDA approved cleaning agents and/or cleaning agents, which are acceptable for use with commercial foodservice equipment. This includes all exterior surfaces of the existing equipment to be reused, and interior work surfaces such as inside oven compartments, fryer vats, ware washers, etc.
- E. All painted items with major paint blemishes to be sanded, primed, and repainted to match the original color and type paint. Primer and paint to be of a type approved for use with commercial foodservice equipment. All controls, lights, view windows, non-painted parts, etc. to be protected as recommended by the Manufacturer. Minor paint blemishes can be touched-up in a professional manner. This work is to be included in the Bid Submittal, as a separate line cost, at the end of the Bid Submittal.
- F. Replace and/or repair minor broken parts to produce a cleanable and functional item. Repairs and/or parts are for minor required items such as control knobs, handles, pilot lamps, belts, oil changes, minor adjustments, and recalibrations, etc. This does not include addition or replacement of any wearing components such as cutters, blades, etc.; or any accessory components such as mixer beaters, hooks, whips, etc., except for presently existing accessory components which are broken and non-functional, or as noted in the itemized specifications.

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- G. Where required by local code authorities, provide additional parts and/or modifications to comply with code requirements in place at the time of this project.
- H. Where required, remove existing equipment to be used after completion of construction from the premises for repairs, alterations, and cleaning.
- I. Refer to schedule on the Foodservice Drawings and to the Itemized Specifications at the end of this section for existing equipment to be used after completion of construction.
- J. Disconnection of existing equipment to be relocated and/or existing equipment to be used in its found place after completion of construction and disconnection and removal/disposal of existing equipment that will not be used after completion of construction, is work as designated by the Architect, and not included in this Section. (See page 11 40 00-2, 1.3.F.)
- K. Cost estimates for any repairs and/or parts more than the minor items stated above, or repairs requiring significant disassembling of the item, should be submitted to the Owner for consideration and approval as an addition to the Contract. In general, this would be considered as any repairs and/or parts amounting to an estimate up to 10% of the cost of a comparable new item. Any item, which would require repairs and/or parts amounting to an estimate up to 25% or more, should include an alternate cost for supplying a comparable new item as a consideration by the Owner, and an addition to the Contract. Estimates are for each existing equipment to be used after completion of construction only that require repairs and/or parts, and only to the extent that work is required; and should not be considered as a lump-sum estimate on all existing equipment to be used after completion of construction combined, or as an allowance for adding accessories or options.

3.12 ITEMIZED SPECIFICATIONS:

- A. Refer to the following pages for specific-information on each item included in this Section.

(Remainder of page left blank intentionally.)

ITEM #B1 PALLET RACK, QTY FIFTY-FIVE (55), BY GC

ITEM #B2 FLOOR SCALE

Quantity: One (1)
Manufacturer: Tufner
Model: TM-54848

Fabricate/Furnish and set in place per plans, details and the following:

1. Complete scale and indicator package. Rugged diamond tread safety deck or smooth stainless steel deck. Deck thickness: 1/4". T900 NTEP indicator with 6 digit, 1" display. Height-adjustable ball and cup leveling feet. Top access to leveling feet and side access to junction box. Channel construction for superior strength. Standard: Four NTEP certified alloy steel load cells. 20' heavy duty metal shielded cable. Anti-corrosion, powder coated steel (standard scales). Factory pre-calibrated for quick setup. Approvals: NTEP Certified at 5,000 divisions, Class III.
2. Pit frame.

ITEM #B3 EYE WASH STATION

Quantity: One (1)
Manufacturer: T&S Brass
Model: EW-7360B

Fabricate/Furnish and set in place per plans, details and the following:

1. Eyewash Unit, wall mount, chrome-plated brass ball valve, 1/2" NPT, 1-1/4" outlet.

ITEM #B4 SPARE NUMBER

ITEM #B5 AIR CURTAIN

Quantity: One (1)
Manufacturer: Mars Air Systems
Model: HV296-2UG-TS

Fabricate/Furnish and set in place per plans, details and the following:

1. High Velocity Series 2 air curtain for 96"W door, unheated, galvanized steel cabinet with Titanium Silver powder coat finish, (2) 1 HP motors, cETLus.
2. Mechanical switches.
3. Door Limit Switch, indoor, plunger/roller type, remote mounted.
4. Door limit switch, plunger/roller type for indoor applications, single pole double throw, 1 HP max, NEMA 1 (remote mounted).
5. Motor control panel for unheated units, remote mounted, (2) 1 HP motor maximum.
6. Disconnect switches, remote mounted by others.
7. Disconnect switch, non-fused, NEMA 1 (to be remote mounted by others).

ITEM #B6 WALK-IN FREEZER

Quantity: One (1)
Manufacturer: Imperial Brown
Model: Prefabricated Panels

Fabricate/Furnish and set in place per plans, details and the following:

1. Walk-in freezer to be prefabricated of modular design and construction.
2. All walk-in panels shall be provided with an overall thickness of 5".
3. Panels to be interchangeable, with U.L. Labeled, CFC free urethane insulation sandwiched between interior and exterior metal surfaces, with an overall thickness of as specified. Edges of panels shall be high-density urethane "tongue and groove", with cam-lock assemblies, set-in-place at time of fabrication. The access ports are to be on the interior, for inside assembly of the walk-in, and shall be covered with "snap caps".
4. Interior ceiling finish shall be 26 ga. stucco white galvalume.
5. Interior walls shall be 26 ga. Stucco galvalume.
6. Exposed exterior of walk-in shall be 26 ga. stucco white glvalume. Exterior finish to be 26 ga. stucco galvalume where not exposed.
7. Heavy duty floor panels. Floor panels shall have foamed in place 0.100" high traffic reinforced aluminum treadplate. Floor panels shall be supplied by cooler panel manufacturer.
8. Walk-in to be installed in building floor recess. Installing Contractor to verify levelness of recess and provide sand and shims as necessary to provide a completely level walk-in floor.
9. Provide a 72" wide x 120" high sliding door. When shown on plan, sliding doors shall be automatic slide doors with stucco galvalume over non-wood frame, a galvanized steel tack, stucco galvalume plug, with 2-1/4" black neoprene sweep. Provide with one (1) 14" x 14"

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- heated view window. Provide with backing for strip curtain. One (1) ea. Low profile sloped sectional hood #LPE-3 for ICC-5 electric slider. One (1) ea. electric lock hasp with inside safety release and tamper-proof screw. One (1) ea. industrial radio set (includes one (1) receiver and two (2) transmitters to operate multiple doors). Sliding door sizing and door operation shall be per drawings.
10. Provide vinyl strip curtains for each door opening.
 11. Fifteen (15) LED light fixtures. Provide extra low temperature LED light fixtures with heavy duty bulbs for field installation by the Electrical Division. All light fixtures to be U.L. listed for use inside walk-in cooler or freezer. All conduit and wiring between light fixtures to be concealed where possible. Refer to foodservice walk in electrical plan for number and location of light fixtures. Provide lighting inside walk-in to meet or exceed 10 foot candles as measured at 12" above finish floor.
 12. Matching finish trim strips, from floor to ceiling, at all exposed vertical edges, corners, and joints to building wall(s). Kitchen Equipment Contractor is responsible for verifying dimensions.
 13. Matching finish closure panels from top of walk-in to finished ceiling, on exposed sides. Kitchen Equipment Contractor is responsible for verifying dimensions, and for providing access panels as necessary, verify with Architect.
 14. Unit and all components to be N.S.F. Approved, U.L. and U.L. Classified with a flame spread of 25 or less, and meet the requirements of N.S.F. Standard #7.
 15. For any installation requiring additional ceiling support, provide self-supporting ceiling structural framework over the top of the walk-in compartment(s), and supported by the walk-in walls.
 16. Verify all dimensions with building conditions for proper fit. Provide maximum size possible to fit available space, using standard panels.
 17. Provide and coordinate seismic details in accordance with local codes.
 18. Refer to QF701 sheet series for further information.

ITEM #B6.1 WALK-IN DOOR MOTOR

Quantity:	Two (2)
Manufacturer:	Imperial Brown
Model:	Custom

Fabricate/Furnish and set in place per plans, details and the following:

1. Included with B6.
2. Refer to QF701 sheet series for further information.

ITEM #B6.2 FREEZER EVAPORATOR COIL

Quantity: Three (3)
Manufacturer: Omni
Model: KMP349VE-T3D

Fabricate/Furnish and set in place per plans, details and the following:

1. Freezer evaporator coil included in refrigeration system.
2. Refer to QF700 sheet series for further information.

ITEM #B6.3 REFRIGERATION RACK

Quantity: One (1)
Manufacturer: Omni
Model: ZF41K5E-TFC

Fabricate/Furnish and set in place per plans, details and the following:

1. One (1) pre assembled, remote, R448A, cooler and freezer compartment refrigeration system. System to consist of condensing unit (high side assembly) and low profile evaporator coil (low side assembly), evaporator mounting kit, automatic electric defrost system, time clock, thermostatic expansion valve, pump down cycle kit, solenoid valve, temperature control, sight glass, drier, vibration eliminator, pressure control, crankcase heater, extreme low ambient controls, weatherproof housing, and any accessories necessary for a completely installed and functional system for a cooler box temp of +35 to + 40 degrees F and a freezer box temp of 10 to 5 degrees F. Verify exact installation location with Architect, architectural plans, and site conditions.
2. Contractor's certified refrigeration mechanic to install all components supplied with the compressor, as per manufacturer's instructions. Also furnish and install refrigeration lines, insulation, refrigerant, drain line heater kit and insulation, and accessories as per manufacturer's instruction's and as required.
3. System shall be designed for outdoor operation.
4. Provide with air-cooled scroll compressor.
5. Refer to QF700 sheet series for further information.

ITEM #B7 WALK-IN COOLER

Quantity: One (1)
Manufacturer: Imperial Brown
Model: Prefabricated Panels

Fabricate/Furnish and set in place per plans, details and the following:

1. Walk-in cooler to be prefabricated of modular design and construction.

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2. All walk-in panels shall be provided with an overall thickness of 5".
3. Panels to be interchangeable, with U.L. Labeled, CFC free urethane insulation sandwiched between interior and exterior metal surfaces, with an overall thickness of as specified. Edges of panels shall be high-density urethane "tongue and groove", with cam-lock assemblies, set-in-place at time of fabrication. The access ports are to be on the interior, for inside assembly of the walk-in, and shall be covered with "snap caps".
4. Interior ceiling finish shall be 26 ga. stucco white galvalume.
5. Interior walls shall be 26 ga. Stucco galvalume.
6. Exposed exterior of walk-in shall be 26 ga. stucco white glvalume. Exterior finish to be 26 ga. stucco galvalume where not exposed.
7. Heavy duty floor panels. Floor panels shall have foamed in place 0.100" high traffic reinforced aluminum treadplate. Floor panels shall be supplied by cooler panel manufacturer.
8. Top set concrete by General Contractor, refer to structural section for requirements.
9. No floor at walk-in cooler. Installing Contractor to verify levelness of building floor as necessary to provide a completely level walk-in floor.
10. Provide one (1) 72" wide x 120" high sliding door. When shown on plan, sliding doors shall be automatic slide doors with stucco galvalume over non-wood frame, a galvanized steel tack, stucco galvalume plug, with 2-1/4" black neoprene sweep. Provide with two (2) 14" x 14" heated view windows. Provide with backing for strip curtain. One (1) ea. Low profile sloped sectional hood #LPE-3 for ICC-5 electric slider. One (1) ea. electric lock hasp with inside safety release and tamper-proof screw. One (1) ea. industrial radio set (includes one (1) receiver and two (2) transmitters to operate multiple doors). Sliding door sizing and door operation shall be per drawings.
11. Provide vinyl strip curtains for each door opening.
12. Nine (9) LED light fixtures. Provide low temperature LED light fixtures with heavy duty bulbs for field installation by the Electrical Division. All light fixtures to be U.L. listed for use inside walk-in cooler or freezer. All conduit and wiring between light fixtures to be concealed where possible. Refer to foodservice walk in electrical plan for number and location of light fixtures. Provide lighting inside walk-in to meet or exceed 10 foot candles as measured at 12" above finish floor.
13. Matching finish trim strips, from floor to ceiling, at all exposed vertical edges, corners, and joints to building wall(s). Kitchen Equipment Contractor is responsible for verifying dimensions.
14. Matching finish closure panels from top of walk-in to finished ceiling, on exposed sides. Kitchen Equipment Contractor is responsible for verifying dimensions, and for providing access panels as necessary, verify with Architect.
15. Unit and all components to be N.S.F. Approved, U.L. and U.L. Classified with a flame spread of 25 or less, and meet the requirements of N.S.F. Standard #7.
16. For any installation requiring additional ceiling support, provide self-supporting ceiling structural framework over the top of the walk-in compartment(s), and supported by the walk-in walls.
17. Verify all dimensions with building conditions for proper fit. Provide maximum size possible to fit available space, using standard panels.
18. Refer to QF701 sheet series for further information.

ITEM #B7.1 WALK-IN DOOR MOTOR

Quantity: Two (2)
Manufacturer: Imperial Brown
Model: CUSTOM

Fabricate/Furnish and set in place per plans, details and the following:

1. Included with B7.
2. Refer to QF701 sheet series for further information.

ITEM #B7.2 COOLER EVAPORATOR COIL

Quantity: One (1)
Manufacturer: Omni
Model: KMP248MA-S2D

Fabricate/Furnish and set in place per plans, details and the following:

1. Freezer evaporator coil included in refrigeration system.
2. Refer to QF700 sheet series for further information.

ITEM #B7.3 REFRIGERATION RACK

Quantity: One (1)
Manufacturer: Omni
Model: ZB38KCE-TF5

Fabricate/Furnish and set in place per plans, details and the following:

1. One (1) pre assembled, remote, R448A, cooler and freezer compartment refrigeration system. System to consist of condensing unit (high side assembly) and low profile evaporator coil (low side assembly), evaporator mounting kit, automatic electric defrost system, time clock, thermostatic expansion valve, pump down cycle kit, solenoid valve, temperature control, sight glass, drier, vibration eliminator, pressure control, crankcase heater, extreme low ambient controls, weatherproof housing, and any accessories necessary for a completely installed and functional system for a cooler box temp of +35 to + 40 degrees F and a freezer box temp of 10 to 5 degrees F. Verify exact installation location with Architect, architectural plans, and site conditions.
2. Contractor's certified refrigeration mechanic to install all components supplied with the compressor, as per manufacturer's instructions. Also furnish and install refrigeration lines, insulation, refrigerant, drain line heater kit and insulation, and accessories as per manufacturer's instruction's and as required.
3. System shall be designed for outdoor operation.
4. Provide with air-cooled scroll compressor.

5. Refer to QF700 sheet series for further information.

ITEM #B8 AIR CURTAIN

Quantity: One (1)
Manufacturer: Mars Air Systems
Model: NH236-1UA-TS

Fabricate/Furnish and set in place per plans, details and the following:

1. High Velocity Series 2 air curtain for 36"W door, sanitation certified to ANSI/NSF 37 standards, unheated, galvanized steel cabinet with Titanium Silver powder coat finish, (1) 1 HP motor, cETLus.
2. Mechanical switches.
3. Door Limit Switch, indoor, plunger/roller type, remote mounted.
4. Door limit switch, plunger/roller type for indoor applications, single pole double throw, 1 HP max, NEMA 1 (remote mounted).
5. Remote mounted switch for Hand-Off-Auto (HOA) control, NEMA 1.

ITEM #B9 SPARE NUMBER

ITEM #B10 SPARE NUMBER

ITEM #B11 WORK STATION, MOBILE

Quantity: One (1)
Manufacturer: Fabricated
Model: Stainless Steel

Fabricate/Furnish and set in place per plans, details and the following:

1. Table, see plans for width, length, height, and configuration.
2. Standard details are to be utilized as basic minimum guidelines only. Refer to these written specifications and any fabrication details included in the contract drawings for precise and complete fabrication instructions. Similar to standard details FSD1-7 and FSD1-10.
3. Island work table with open base similar to detail FSD2-2.
4. 5" Heavy-duty casters, two (2) with brakes.
5. Straight turn-down edge profile similar to detail FSD1-1A.
6. Refer to QF501 and QF600 sheet series for further information.

ITEM #B12 OFFICE COMPUTER, QTY ONE (1), BY OWNER

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ITEM #B13 AIR CURTAIN

Quantity: Two (2)
Manufacturer: Mars Air Systems
Model: STD2120-3UG-OB

Fabricate/Furnish and set in place per plans, details and the following:

1. Standard Series 2 air curtain for 120"W door, unheated, galvanized steel cabinet with Obsidian Black powder coat finish, (3) 1/2 HP motors, cETLus.
2. Magnetic Reed Switch, commercial, surface mounted.
3. Motor control panel for unheated units, remote mounted, (3) 1/2 HP motor maximum.
4. Magnetic reed switch, commercial plastic body for surface mounted applications, . NEMA 1 (requires controller, or motor control panel wth MCP-24v).
5. Accessory, panel mounted 24v transformer (adder for motor control panel).
6. Disconnect switches, remote mounted by others.
7. Disconnect Switch, fused, 3-pole, NEMA 3R (to be remote mounted by others).

END OF 11 40 00 FOODSERVICE EQUIPMENT

SECTION 21 13 00
FIRE SUPPRESSION SPRINKLER SYSTEM

PART 1 – GENERAL

1.1 REFERENCES:

- A. AMERICAN IRON AND STEEL INSTITUTE (AISI)
 - 1. AISC/AISI 121 (2007) Standard Definitions for Use in the Design of Steel Structures
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME A112.18.1 (2018) Plumbing Supply Fittings
 - 2. ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)
 - 3. ASME/ANSI B16.1 (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
 - 4. ASME/ANSI B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300
 - 5. ASME/ANSI B16.4 (2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C111/A21.11 (2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 2. AWWA C151/A21.51 (2017) Ductile-Iron Pipe, Centrifugally Cast
 - 3. AWWA C900 (2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4-inch Through 60-inch
- D. ASTM INTERNATIONAL (ASTM)
 - 1. ASTM A47/A47M (1999) Standard Specification for Ferritic Malleable Iron Castings
 - 2. ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A135/A135M (2009; R2014) Standard Specification for Electric-Resistance-Welded Steel Pipe
 - 4. ASTM A234/A234M (2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
 - 5. ASTM A536 (1984) Standard Specification for Ductile Iron Castings
 - 6. ASTM D1784 (2020) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- E. FM GLOBAL (FM)
 - 1. FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>
- F. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. NFPA 13 (2022) Standard for the Installation of Sprinkler Systems
2. NFPA 24 (2019) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

G. UNDERWRITERS LABORATORIES (UL)

1.2 ADMINISTRATIVE REQUIREMENTS:

- A. Conduct a survey of the work area. Commencement of work constitutes acceptance of existing conditions.
- B. Convene one week before starting work of this section for preinstallation meeting.

1.3 SUBMITTALS:

- A. Submit the following in accordance with DIVISION 01 – GENERAL REQUIREMENTS.

1. Shop Drawings

- a. Shop drawings prepared in accordance with NFPA 13, including hydraulic calculations that are approved by the Authority Having Jurisdiction. Drawings shall have the approval of a Professional Engineer registered in the state in which the project is located. Drawings to consist of the following, refer to NFPA 13 “Plans and Calculations” for a comprehensive list of items to be included:
 - i. Piping plan view and/or Reflected Ceiling Plan (RCP) drawing(s) indicating relationship of all other trades and approved sprinkler head locations.
 - ii. Details and sections to clearly identify design intent.
 - iii. Plans shall include: Seismic zones of influence, hydraulic remote areas, elevations of pipe, attachment locations and type, zones and associated coverage areas, volume of dry system(s) (if applicable), locations of seismic separation and expansion joints, hose cabinet locations, drain locations, primary fire pumps, secondary pumps, supply, pressure maintenance pumps, controllers, drivers and accessories.

2. Product Data

- a. Provide data on piping, valves, sprinklers, hangers/supports, hose cabinets, notification devices, specialties and accessories. Product data shall include manufacturers catalog information with performance ratings, rough-in details, finish, weights, and installation requirements.
 - i. Each product shall be referred to on submittals, drawings, and other documentation, by the identification or model number as specifically published in the appropriate agency listing or approval.

3. Design Data

- a. Provide detailed hydraulic calculations that clearly demonstrate that the water supply will meet the demand of the sprinkler system and hose streams. Calculations shall accompany design drawings and shall be based on a water flow test conducted at the site within six (6) months of the submittal of plans for approval. Flow test information and associated nodes shall be documented on shop drawings and include a site plan.
 - b. Provide complete seismic calculations that clearly reflect seismic restraint with supporting site specific force factor and attachment details used, relative to an associated zone of influence.
4. Test Reports
 - a. Contractor's Material & Test Certificate Reports in accordance with NFPA for above ground piping, underground piping, pressure, system operation, air, valve and drain tests.

1.4 QUALITY ASSURANCE:

- A. Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, or Factory Mutual approved.
- B. Company specializing in performing the work of this section shall have a minimum of five years experience and approved by manufacturer.
- C. Manufacturing Company shall be one specializing in manufacturing the products specified with a minimum three years documented experience.

1.5 COORDINATION:

- A. The Contractor shall coordinate and reflect routing and location of equipment, devices, and materials with other disciplines, where not already indicated, on the design documents. Indicate required space for routine maintenance and inspection, including location and sizes of access doors.

PART 2 – PRODUCTS

2.1 SYSTEM DESCRIPTION:

- A. All fire protection system materials and equipment shall be Underwriters Laboratories (UL) listed or the Factory Mutual (FM) approved for its intended use.

2.2 EQUIPMENT:

- A. Aboveground Piping Materials
 1. BCS - Black Carbon Steel

- a. All piping 2-inch and smaller: Schedule 40, black-carbon steel conforming to ASTM A53, or ASTM A135, threaded or roll grooved ends. All 1-inch pipe shall have threaded ends.
- b. All Piping 2-1/2-inch through 8 inch: Schedule 10, black carbon steel conforming to ASTM A53 or ASTM A135, roll grooved ends.

B. Fittings and Couplings

- 1. Cast-Iron Threaded Fittings:
 - a. ASME/ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- 2. Malleable-Iron Threaded Fittings:
 - a. ASME/ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.2.1.
- 3. Steel Fittings:
 - a. ASTM A234/A234M, seamless or welded, for welded joints.
- 4. Grooved Mechanical Fittings:
 - a. ASTM A536, Grade 65-45-12 ductile iron; ASTM A47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S, Grade B fabricated steel fittings with grooves or shoulders designed to accept grooved end couplings.
- 5. Grooved Mechanical Couplings:
 - a. consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking in, locking toggle, or lugs to secure roll-grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.
- 6. Cast-Iron Flanges:
 - a. ASME/ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.
- 7. Unions:
 - a. Malleable iron, Class 150 hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces, female threaded ends. Threads shall conform to ASME B1.20.1.
- 8. Dielectric Unions:
 - a. Threaded, solder, or grooved-end connections as required to suit application, constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

C. Pipe Hangers and Supports

- 1. Shall be UL listed and shall meet requirements of NFPA 13 for type, dimension and location.

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. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
5. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
6. Vertical Support: Steel riser clamp.
7. Hanger Rods: Use only circular solid cross section rod hangers to connect building structure attachments to pipe-support devices. Use pipe, straps, or bars of equivalent strength for hangers.

D. Alarm Devices

1. General: Types and sizes shall mate and match piping and equipment connections.
2. Water Flow Indicators (Wet-pipe Systems): vane type waterflow detector, rated to 250 psi; designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 Volts DC; completed with factory-set, field-adjustable retard element to prevent false signals, and tamperproof cover.
3. Electric Alarm Bell: UL listed 10" electric operated factory painted alarm bell with weatherproof bell kit and bell guard. Bell shall have minimum 90 decibel rating. Provided engraved plate under Bell lettered "Building Standpipe and Sprinkler System."
4. Supervisory Switches: SPST, normally closed contacts, designed to signal valve in other than full open position and tamperproof cover.

2.3 AUTOMATIC SPRINKLERS:

- A. Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only.

1. Sprinkler Finishes: Provide sprinklers and matching escutcheons as indicated in the contract documents or as approved by Owner or Architect. All sprinklers are to be glass bulb type unless otherwise approved by Owner or Architect.
2. Pendent Sprinkler
 - a. Pendent sprinkler must be recessed quick response type with nominal K-factor of 5.6. Pendent sprinklers must have an architect approved finish. Assembly must include an integral and matching escutcheon.
3. Upright Sprinkler
 - a. Upright sprinkler must be quick-response type and have a nominal K-factor of 5.6.
4. Concealed Sprinkler
 - a. Concealed sprinkler must be quick-response type and have a nominal K-factor of 5.6. Cover plate must match ceiling.
5. Dry sprinkler

- a. Dry sprinkler assembly must be of the pendent type. Assembly must include an integral escutcheon. Maximum length must not exceed maximum indicated in its listing. Sprinkler must have an architect approved finish.
- B. Sprinkler Cabinet and Wrench: Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.
- C. Head Protection
 1. Protect heads with paper or plastic bags during painting operations. Remove protection immediately upon finishing painting operations.
 2. Provide head guards wherever mechanical damage could occur. Guard finish to be red enamel.
- D. Aboveground Valves
 1. Ensure gate, globe, and check valves (all sizes) are FM approved or UL listed.
 2. Ensure ball valves, 2 inches and under, are FM approved, rated 300 psi, with provisions to wire or lock handle in place where critical alarm function may be isolated.
 3. Ensure butterfly valves, 6-inches and larger are FM approved, rated 175 psi, cast-iron bodied wafer type, with elastomer liners and seals.
- E. Paints and Coatings
 1. Paints and coatings must comply with:
 - a. The California Department of Public Health (CDPH) Standard Method v1.1-2010 general testing and emissions evaluation requirements.
 - b. All paints/coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (2007), Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
- F. Adhesives, Sealants, and Sealant Primers
 1. Adhesives, sealants, and sealant primers must comply with:
 - a. The California Department of Public Health (CDPH) Standard Method v1.1-2010 general testing and emissions evaluation requirements.
 - b. All adhesives, sealants, and sealant primers wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by methods specified in Rule 1168.

PART 3 – EXECUTION

3.1 PREPARATION:

A. Painting

1. If manufacturer's standard-finish equipment surfaces are damaged during construction, bring to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Owner.

3.2 INSTALLATION:

- A. Ensure installation of system materials and equipment is in accordance with the recommendations and provisions of NFPA 13 and NFPA 24. Perform work in the presence of the Contracting Officer.
- B. Perform all installation work by licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed.

3.3 ABOVEGROUND PIPING INSTALLATION:

- A. Locations and Arrangements: Coordinate installation of horizontal piping with other components. Allow sufficient space above removable ceiling panels to allow for panel removal.
- B. Install system such that all piping is rigidly secured and supported. Cutting of structural members for passage of sprinkler pipes or hangers will not be permitted. Route all sprinkler piping and provide all offsets, bends and elbows around all mechanical, electrical, and structural members as required. In areas with ceilings, piping shall be routed concealed, above ceiling. In areas without ceilings, piping shall extend as high as possible.
- C. Deviations from approved "Working Plans" for sprinkler piping require written approval of the Authority Having Jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "Working Plans."
- D. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.
- E. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- F. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger support spacing and locations for piping joined with grooved mechanical couples shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake if required by the applicable building code, designed in accordance with NFPA 13.
- G. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.

- H. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.
- I. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.
- J. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than ¼ inch and having a soft metal seated globe valve arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.
- K. Install automatic air vent at high point of system(s) in accordance with NFPA 13.
- L. Sleeves
 - 1. Provide sleeves where piping passes through roofs, masonry or concrete walls, or floors.
 - 2. Continuously weld or braze sleeves to the deck when passing through steel decks.
 - 3. Install sleeves that are continuous when extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers. Fabricate sleeves from Schedule 40 steel pipe with welded anchor lugs. Form other sleeves by molded linear polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally provides a minimum 3/8-inch clearance. Install sleeve to accommodate mechanical and thermal motion of pipe and to preclude transmission of vibration to walls and generation of noise.
 - 4. Pack solid the space between a pipe and the inside of a pipe sleeve or a construction surface penetration or wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Use a mineral fiber. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration with an elastomer caulk to a depth of 1/2 inch. Ensure surfaces are oil- and grease-free before caulking.
 - 5. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- M. Escutcheons
 - 1. Install escutcheons at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, attach plates at the underside only of such ceilings. Use chrome plated escutcheons in occupied

spaces and conceal openings in building construction. Ensure escutcheons are firmly attached.

3.4 FIELD QUALITY CONTROL:

A. System Testing

1. Prior to acceptance of the work, test completed systems in the presence of the Contracting Officer. Upon approval, provide certificates of testing.
2. Conduct a hydrostatic test, unless otherwise specified. Use only potable water for testing.
3. Perform air tests, valve-operating tests, and drainage tests for dry-pipe systems.
4. Perform full-flow system operating tests for standpipe systems.
5. Prepare and maintain test records of piping-system tests. Ensure records show personnel responsibilities, dates, test-gage identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates.
6. Each test acceptance requires the signature of the Contracting Officer.

B. Test Gauges

1. Acceptable test gages have 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes.

C. Pneumatic Testing

1. Perform pneumatic Pressure Tests when freezing conditions may occur and upon prior approval by the Contracting Officer. Use oil-free compressed air used for testing.

D. Test and Acceptable Criteria

1. Perform above ground systems pressure tests at 200 psi and maintain the applied pressure without further addition of test media for not less than 2 hours. No pressure drop is allowed.
2. Test underground rubber-jointed ferrous-pipe water systems at 200 psi, and maintain the applied test pressure for not less than 2 hours. Maximum allowable pressure drop is 2 psi. After satisfactory hydrostatic testing, test piping for leakage as follows:
 - a. Duration of each leakage test is not less than 2 hours; during the test, subject the main to 200 psi pressure based on the elevation of the lowest section under test and corrected to the elevation of the test gage.

- b. Leakage is defined as the quantity of water supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
 - c. Amount of leakage at the joints cannot exceed 2 quarts per 100 joints regardless of pipe diameter.
 - d. Apply hydrostatic tests to piping with concrete thrust blocking only after the concrete has cured for more than 7 calendar days.
- 3. Test backflow prevention into connected potable-water systems and system devices for proper functioning under conditions normal to their application. Repair dripping or weeping joints.

3.5 ADJUSTING AND CLEANING:

- A. At the completion of the work, clean all parts of the installation. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Adjust automatic control devices for proper operation.

3.6 PROTECTION:

A. Flushing

- 1. Before overhead sprinkler piping can be connected to the underground piping, verification of an approved hydrostatic test and flush must be furnished.

END OF SECTION

SECTION 21 13 13

WET PIPE SPRINKLER SYSTEMS FIRE PROTECTION

PART 1 - GENERAL

1.1 REFERENCES:

A. AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

1. ASSE 1013 (2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
2. ASSE 1015 (2011) Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

B. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C104/A21.4 (2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. AWWA C203 (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
3. AWWA M14 (2015) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control

C. ASTM INTERNATIONAL (ASTM)

1. ASTM A47/A47M (1999) Standard Specification for Ferritic Malleable Iron Castings
2. ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A183 (2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
4. ASTM A536 (1984) Standard Specification for Ductile Iron Castings

D. FM GLOBAL (FM)

1. FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>
2. FM 1637 (2010) Flexible Sprinkler Hose with Threaded End Fittings

E. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. NFPA 13 (2022) Standard for the Installation of Sprinkler Systems

2. NFPA 24 (2019) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
3. NFPA 291 (2016) Recommended Practice for Fire Flow Testing and Marking of Hydrants

F. UNDERWRITERS LABORATORIES (UL)

1.2 SYSTEM DESCRIPTION:

A. Hydraulic Design

1. Basis for Calculations
 - a. Perform a fire hydrant flow test prior to shop drawing submittal in accordance with NFPA 291. Results must include hydrant elevations relative to the building and hydrant number/identifiers for the tested hydrants, including which were flowed, which had a gauge. This information must be presented in a tabular form if multiple hydrants were flowed. The results must be included with the hydraulic calculations. Hydraulic calculations must be based on flow test noted in this paragraph. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping.
2. Hydraulic Calculations
 - a. Water supply curves and system requirements must be plotted on semi-logarithmic graph.
 - b. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, minimum discharge pressures and minimum flows. Elevations of hydraulic reference points (nodes) must be indicated.
 - c. Documentation must identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.
 - d. Where the sprinkler system is supplied by interconnected risers, the sprinkler system must be hydraulically calculated using the hydraulically most demanding single riser. The calculations must not assume the simultaneous use of more than one riser.
 - e. All calculations must include the backflow preventer manufacturer's stated friction loss at the design flow.
 - f. All calculations must be performed back to the actual location of the flow test, taking into account the direction of flow in the service main at the test location.
 - g. For gridded systems, calculations must show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. A flow diagram indicating the quantity and direction of flows must be included.
3. Design Criteria

- a. Hydraulically design the system to discharge a minimum density as indicated on the drawings or must be in accordance with the Area/Density Method of NFPA 13. Add an allowance for exterior and interior hose streams as required by NFPA 13.

B. Sprinkler Coverage

1. Sprinklers must be uniformly spaced on branch lines. Provide coverage throughout 100 percent of the area noted on the Contract drawings. This includes, but is not limited to, telephone rooms, electrical equipment rooms (regardless of the fire resistance rating of the enclosure), boiler rooms, switchgear rooms, transformer rooms, attached electrical vaults and other electrical and mechanical spaces. Coverage per sprinkler must be in accordance with NFPA 13. Provide sprinklers below all obstructions in accordance with NFPA 13.

C. Qualified Fire Protection Engineer (QFPE)

1. An individual who is a licensed professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience.

1.3 SUBMITTALS:

- A. Shop drawings, product data and calculations must be prepared by the designer and combined and submitted as one complete package. The QFPE must review the submittal package for completeness and compliance with the Contract provisions prior to submission.

B. Submit the following:

1. Shop Drawings
2. Product Data
 - a. Pipe
 - b. Fittings
 - c. Valves, including gate, check, butterfly, and globe
 - d. Alarm Valves
 - e. Relief Valves
 - f. Sprinklers
 - g. Pipe hangers and Supports
 - h. Sprinkler alarm switch
 - i. Valve supervisory (tamper) switch
 - j. Fire department connection
 - k. Backflow prevention assembly
 - l. Air vent
 - m. Hose valve
 - n. Seismic bracing

- o. Nameplates
- 3. Design Data
 - a. Seismic bracing
 - b. Load calculations for sizing of seismic bracing
 - c. Hydraulic calculations
- 4. Test Reports
 - a. Test procedures
- 5. Certificates
 - a. Verification of Compliant Installation
- 6. Operation and Maintenance Data
 - a. Operating and Maintenance (O&M) Instructions
 - b. Spare Parts Data
- 7. Closeout Submittals
 - a. As-built drawings

1.4 QUALITY ASSURANCE:

- A. Preconstruction Submittals - Within 36 days of contract award but no less than 14 days prior to commencing work on site, the prime Contractor must submit drawings, calculations and product data for review and approval.
 - 1. Shop Drawing -copies of the shop drawings, no later than 28 days prior to the start of system installation. Working drawings conforming to the requirements prescribed in NFPA 13. Each set of drawings must include the following:
 - a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 - b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, and other details required to clearly describe the proposed arrangement.
 - c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross mains and branch lines to finished floor and roof or ceiling.
 - d. Longitudinal and transverse building sections showing typical branch line and cross main pipe routing, elevation of each typical sprinkler above finished floor and elevation of "cloud" or false ceilings in relation to the building ceilings.
 - e. Plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.
 - f. Riser layout drawings drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.

- g. Details of each type of riser assembly, pipe hanger, sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. The dimension from the edge of vertical piping to the nearest adjacent wall(s) must be indicated on the drawings when vertical piping is located in stairs or other portions of the means of egress.
 - h. Details of each type of pipe hanger, seismic bracing/restraint and related components.
 - i. Include fire pump curve with shop drawings and hydraulic calculations, if applicable.
- 2. Product Data
 - a. Annotated catalog data to show the specific model, type, and size of each item. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.
- 3. Hydraulic Calculations
 - a. Calculations must be as outlined in NFPA 13 except that calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings.
- 4. Operating and Maintenance Instructions
 - a. Provide 3 hard copy manuals and one pdf version on electronic media. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

B. Qualifications

- 1. Sprinkler System Designer
 - a. The sprinkler system designer must be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology.
- 2. Sprinkler System Installer
 - a. The sprinkler system installer must be regularly engaged in the installation of the type and complexity of system specified in the contract documents, and must have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

C. Regulatory Requirements

- 1. Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission

of these terms under the description of an item or equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation are mandatory requirements.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. All pipes must be either capped or plugged until installed.

1.6 Extra Materials

- A. Spare sprinklers and wrench(es) must be provided as spare parts in accordance with NFPA 13.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Standard Product

- 1. Provide materials, equipment, and devices listed for fire protection service when so required by NFPA 13 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for a classification of material. Material and equipment must be standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid.

B. Nameplates

- 1. Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Nameplates must be etched metal or plastic, permanently attached by screws to control units, panels or adjacent walls.

C. Identification and Marking

- 1. Pipe and fitting markings must include name or identifying symbol of manufacturer and nominal size. Pipe must be marked with ASTM designation. Valves and equipment markings must have name or identifying symbol of manufacturer, specific model number, nominal size, name of device, arrow indicating direction of flow, and position of installation (horizontal or vertical), except if valve can be installed in either position. Markings must be included on

the body casting or on an etched or stamped metal nameplate permanently on the valve or cover plate.

D. Pressure Rating

1. Valves, fittings, couplings, alarm switches, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than 175 psi.

2.2 ABOVEGROUND PIPING COMPONENTS:

A. Steel Piping Components

1. Steel Pipe

- a. Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53, ASTM A135 or ASTM A153.
- b. Steel pipe must be minimum Schedule 40 for sizes 2 inches and less; and minimum Schedule 10 for sizes larger than 2 inches.

2. Fittings

- a. Fittings must be welded, threaded, or grooved-end type. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable-iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe, steel press fittings and field welded fittings are not permitted. Fittings, mechanical couplings, and rubber gaskets must be supplied by the same manufacturer. Threaded fittings must use Teflon tape or manufacturer's approved joint compound. Saddle tees using rubber gasketed fittings are permitted only when connecting to existing piping for additions or modifications. Saddle tees must use a connection method that completely wraps around the pipe. Reducing couplings are not permitted except as allowed by NFPA 13.

3. Grooved Mechanical Joints and Fittings

- a. Joints and fittings must be designed for not less than 175 psi service and the product of the same manufacturer. Field welded fittings must not be used. Fitting and coupling housing must be malleable-iron conforming to ASTM A47, Grade 32510; ductile-iron conforming to ASTM A536, Grade 65-45-12. Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 2 inches and larger. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium-plated or zinc-electroplated.

4. Flanges

- a. Flanges must conform to NFPA 13 and ASME 816.1. Gaskets must be non-asbestos compressed material in accordance with ASME 816.21, 1/16-inch thick, and full face or self-centering flat ring type.

B. Flexible Sprinkler Hose

1. The use of flexible hose is permitted. Flexible sprinkler hose must comply with UL 2443 and FM 1637.

C. Pipe Hangers and Supports

1. Provide galvanized pipe hangers, supports and seismic bracing in accordance with NFPA 13. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes for Seismic Design Category as designated by the Structural Engineer of Record.

D. Valves

1. Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.
2. Control Valve
 - a. Manually operated sprinkler control/gate valve must be outside stem and yoke (OS&Y) type or butterfly type as indicated on the drawings and must be listed.
3. Check Valves
 - a. Check valves must comply with UL 312
4. Hose Valve
 - a. Valve must comply with UL 668.

2.3 ALARM INITIATING AND SUPERVISORY DEVICES:

A. Sprinkler Alarm Switch

1. Vane or pressure-type flow switch(es). Connection of switch must be by the fire alarm installer. Vane type alarm actuating devices must have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and must instantly recycle. Flow switches for elevator power shunt must not have a retard feature.

B. Valve Supervisory (Tamper) Switch

1. Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open.

2.4 SPRINKLERS:

- A. Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only.
- B. Pendent Sprinkler
 - 1. Pendent sprinkler must be recessed quick response type with nominal K-factor of 5.6. Pendent sprinklers must have an architect approved finish. Assembly must include an integral and matching escutcheon.
- C. Upright Sprinkler
 - 1. Upright sprinkler must be quick-response type and have a nominal K-factor of 5.6.
- D. Concealed Sprinkler
 - 1. Concealed sprinkler must be quick-response type and have a nominal K-factor of 5.6. Coverplate must match ceiling.
- E. Corrosion-Resistant Sprinkler
 - 1. Corrosion-resistant sprinkler to be installed in locations as indicated. Corrosion-resistant coatings must be factory-applied by the sprinkler manufacturer.
- F. Dry sprinkler
 - 1. Dry sprinkler assembly must be of the pendent type. Assembly must include an integral escutcheon. Maximum length must not exceed maximum indicated in its listing. Sprinkler must have an architect approved finish.

2.5 ACCESSORIES:

- A. Sprinkler Cabinets
 - 1. Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.
- B. Pendent Sprinkler Escutcheon

1. Escutcheon must be one-piece metallic type with a depth of less than 3/4-inch and suitable for installation on pendent sprinklers. The escutcheon must have a factory finish that matches the pendent sprinkler.

C. Pipe Escutcheon

1. Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

D. Sprinkler Guard

1. Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located within 7 feet of the floor and/or as indicated.

E. Relief Valve

1. Relief valves must be listed and installed at the riser in accordance with NFPA 13.

F. Air Vent

1. Air vents must be of the automatic type and piped to drain to the building exterior.

G. Identification Sign

1. Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 - EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS:

- A. Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative a condition that prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION:

- A. The installation must be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.
 - 1. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.
 - 2. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to ensure all Contractors have the information necessary so that they may properly install all necessary connections and equipment.
 - 3. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.
- B. Waste Removal
 - 1. At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 ABOVEGROUND PIPING INSTALLATION:

- A. The methods of fabrication and installation of the aboveground piping must fully comply with the requirements and recommended practices of NFPA 13 and this specification section.
- B. Protection of Piping Against Earthquake Damage
 - 1. Seismic restraint is required.
- C. Piping in Exposed Areas
 - 1. Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, must be installed to provide maximum headroom.
- D. Piping in Finished Areas
 - 1. In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping must be concealed above ceilings. Piping must be

inspected, hydrostatically tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas must be concealed.

E. Pendent Sprinklers

1. Drop nipples to pendent sprinklers must consist of minimum 1-inch pipe with a reducing coupling into which the sprinkler must be threaded.
2. Where sprinklers are installed below suspended or dropped ceilings, drop nipples must be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling must not extend below the underside of the ceiling.
3. Recessed pendent sprinklers must be installed such that the distance from the sprinkler deflector to the underside of the ceiling must not exceed the manufacturer's listed range and must be of uniform depth throughout the finished area.
4. Pendent sprinklers in suspended ceilings must be located in the center of the tile (plus or minus 2 inches).
5. Dry pendent sprinkler assemblies must be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space.
6. Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 100 psi and a branch line above the ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported arm-over to a sprinkler or sprinkler drop must not exceed 12 inches for steel pipe.

F. Upright Sprinklers

1. Riser nipples or "sprigs" to upright sprinklers must contain no fittings between the branch line tee and the reducing coupling at the sprinkler.

G. Pipe Joints

1. Pipe joints must conform to NFPA 13, except as modified herein. Not more than four threads must show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints must be provided where indicated or required by NFPA 13. Grooved pipe and fittings must be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools must be products of the same manufacturer. For copper tubing, pipe and groove dimensions must comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field must be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer.

for the intended application. Groove width and dimension of groove from end of pipe must be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

H. Reducers

1. Reductions in pipe sizes must be made with one-piece tapered reducing fittings. When standard fittings of the required size are not manufactured, single bushings of the face or hex type will be permitted. Where used, face bushings must be installed with the outer face flush with the face of the fitting opening being reduced. Bushings cannot be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2-inch.

I. Pipe Penetrations

1. Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors must be core-drilled and provided with pipe sleeves. Each sleeve must be Schedule 40 galvanized steel, ductile-iron or cast-iron pipe and extend through its respective wall or floor and be cut flush with each wall surface. Sleeves must provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.
2. Where pipes and sleeves penetrate fire walls, fire partitions, or floors, pipes/sleeves must be firestopped.
3. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

J. Escutcheons

1. Escutcheons must be provided for pipe penetration in finished areas of ceilings, floors and walls. Escutcheons must be securely fastened to the pipe at surfaces through which piping passes.

K. Inspector's Test Connection

1. Unless otherwise indicated, the test connection must consist of 1-inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test". All test connection piping must be inside of the building and penetrate the exterior wall at the location of the discharge orifice only. The discharge orifice must be located outside the building wall no more than 2 feet above finished grade, directed so as not to cause damage to adjacent construction or landscaping during full flow discharge, or to the

sanitary sewer. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building. Do not discharge to the roof. Discharge to floor drains, janitor sinks or similar fixtures is not permitted.

2. Provide concrete splash block at drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

L. Drains

1. Main drain piping must be provided to discharge at a safe point outside the building, no more than 2 feet above finished grade, or to the sanitary sewer where dictated by jurisdiction. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.
2. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

M. Identification Signs

1. Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13.

3.4 ELECTRICAL:

- A. Alarm signal wiring connected to the building fire alarm control system must be by the fire alarm installer.

3.5 FIELD QUALITY CONTROL:

A. Correction of Deficiencies

1. If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.6 MINIMUM SYSTEM TESTS:

- A. The system, including the underground water mains, and the aboveground piping and system components, must be tested to ensure that equipment and components function as intended. The underground and aboveground interior piping systems and attached

appurtenances subjected to system working pressure must be tested in accordance with NFPA 13.

B. Aboveground Piping

1. Hydrostatic Test

- a. Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.

C. Main Drain Flow Test

1. Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply.

3.7 SYSTEM ACCEPTANCE:

- A. Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

1. Provide one set of full size paper as-built drawings and schematics. The drawings must be prepared electronically and sized no less than the contract drawings.
2. Provide operating and maintenance (O&M) instructions.

3.8 ONSITE TRAINING:

- A. Conduct a training course for the responding fire department and operating and maintenance personnel as designated by the Contracting Officer. The on-site training must cover all of the items contained in the approved Operating and Maintenance Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Basic Plumbing Requirements specifically applicable to Division 22 Sections, in addition to Division 01 - General Requirements.

1.2 DESCRIPTION:

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

1.3 REFERENCES:

- A. Section 230801 - Commissioning of Building Systems

1.4 WORK INCLUDED:

- A. The complete Plumbing systems (including Fire Protection systems), including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions and location of existing utilities at the jobsite.
 - 3. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 4. Soil waste and vent system inside and outside the building, including connections to fixtures, equipment, sewer connections, clean-outs.
 - 5. Water piping systems inside and outside the building, including connections to fixtures, equipment, water meters and vaults; pressure regulating stations, backflow preventers.
 - 6. Plumbing fixtures, carriers, fittings, trim, hose bibs, wall hydrants, and accessories.
 - 7. Installation and connection of Owner furnished equipment.
 - 8. Water heating systems, including water heating equipment, circulating pumps, connections.
 - 9. Shop drawings.

10. Equipment identification.
11. Equipment and systems adjustments and balancing.
12. Written operating and maintenance instructions.
13. Record drawings.
14. Guarantee

1.5 WORK SPECIFIED ELSEWHERE:

- A. Concrete, Rough Carpentry, Joint Sealants, Sheet Metal, Flashing and Trim, access doors and Frames, Door Hardware, Paints and Coatings, Mechanical and Electrical.

1.6 SITE INSPECTION:

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

1.7 ORDINANCES, REGULATIONS AND CODES:

- A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.
 1. AFI - Air Filter Institute
 2. AMCA - Air Moving & Conditioning Association
 3. ARI - Air Conditioning & Refrigeration Institute
 4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 5. ASME - American Society of Mechanical Engineers
 6. ASTM - American Society of Testing Materials
 7. AWS - American Welding Society Code
 8. ANSI - American National Standards Institute
 9. CBC - California Building Code
 10. CCR - California Code of Regulations
 11. CEC - California Electrical Code

12. CFC - California Fire Codes
 13. CMC - California Mechanical Code
 14. CPC - California Plumbing Code
 15. FIA - Factory Insurance Association
 16. NAFM - National Association of Fan Manufacturers
 17. NEMA - National Electrical Manufacturer's Association
 18. NFPA - National Fire Protection Association
 19. ORS - Office of Regulatory Services
 20. SCAQMD - South Coast Air Quality Management District
 21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
 22. UFC - Uniform Fire Code
 23. UL - Underwriter's Laboratories
 24. UPC - Uniform Plumbing Code
- B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.
- C. Codes and Standards:
1. IBC and California Amendments (California Building Code - Part 2, Title 24, CCR).
 2. UMC and California Amendments (California Mechanical Code - Part 4, Title 24 CCR).
 3. UPC and California Amendments (California Plumbing Code - Part 5, Title 24 CCR).
 4. Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24 CCR).
 5. National Fire Protection Associations - National Fire Code.

- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.
- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.8 PERMITS, FEES AND INSPECTIONS:

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

1.9 DRAWINGS AND SPECIFICATIONS:

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

1.10 SUBMITTALS:

- A. Before starting work, the Contractor shall furnish for the review of the Architect and Engineer. Provide Shop Drawings and Submittals with Itemized Equipment Lists, complete in all details that they proposes to install. All items shall be submitted at the same time.
- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.

- C. Variations or deviations on submitted items from that specified must be clearly tagged and / or identified.
- D. Submittals shall include, but not necessarily be limited to the following which are mandatory:
1. Draw Equipment Layouts to 1/4" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
 2. Schedule of pipe, fittings, valves, with manufacturer and catalog number.
 3. Specialties, valves, gauges and thermometers of all types.
 4. Foundations, supports, hangers, inserts.
 5. Earthquake supports and calculations.
 6. Insulation.
 7. Shop fabrication drawings and installation drawings of piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping to finish floor level.
 8. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
 9. Automatic control system diagrams.
 10. Access panels.
 11. Clean-outs
 12. Fixture carriers.
 13. Hangers, inserts, supports, anchors.
 14. Hose bibs.
 15. Hot water circulators.
 16. Pipe, fittings and specialties.
 17. Pipe isolators.
 18. Plumbing fixtures, fittings, trim, drains and receptors.
 19. Pressure regulators.
 20. Roof flashing.

21. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
22. Strainers
23. Water hammer arrestors.
24. Water heating equipment.
25. Expansion joints, guides and anchors.
26. Shop fabrications drawings and calculations.
27. Special and miscellaneous products furnished under this section and not listed herein.

1.11 RECORD DRAWINGS AND MANUALS:

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 1 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
 1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 2. Specifications

3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 4. Grouting requirements.
 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.
 6. Start-up and beginning operation procedures.
 7. Operational procedures.
 8. Shutdown procedures.
 9. Maintenance and calibration procedures
 10. Parts lists
 11. Name, address and telephone number of each manufacturer's local representative.
- H. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided prior to commencement of air and water balance.

1.12 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP:

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

1.13 SEISMIC DESIGN:

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure including calculations for approval by structural engineer or for approval by inspector of record, as applies, for items or work, where approval is deferred or where alternate support or anchorage detail is proposed to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. Anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. (Building equipment and connections therefore shall be designed to resist lateral seismic forces equal to 1.0 of equipment weight to working allowable stress. Cantilevered posts supporting equipment shall be designed to resist lateral seismic forces equal to 0.5 of equipment weight to allowable working stress. Conform to the following:

1. In accordance with Title 24, 2022 CBC Chapter 16A, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
2. For equipment weighing 400 pounds or more anchorage details and appropriate design calculations shall be submitted as part of the mechanical and electrical drawings. "Deferred Approval" items will not be permitted unless specifically approved by the plan check supervisor.
 - a. Exception: Attachments of equipment weighing less than 400 pounds and supported directly on the floor or roof structure, furniture, or temporary or movable equipment and equipment weighing less than 20 pounds that is supported by vibration isolation devices suspended from the roof, wall or floor, need not be detailed on the plans provided the following notes are included on the mechanical and electrical plans.
3. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2022 CBC Chapter 16A. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

1.14 SUBSTITUTIONS AND CHANGES:

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

1.15 SUBMITTAL REVIEWS:

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

1.16 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS:

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

1.17 LOCATIONS AND ACCESSIBILITY:

- A. Drawings show piping diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping and make offsets during progress of work as required to meet structural and other interferences as reviewed by Architect and / or Engineer. Install piping to best suit field conditions after coordinating with other trades. Run exposed piping parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.
- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, clean outs, controls, steam and water specialties, access doors or any other indicating equipment or specialties requiring reading, adjustment, inspection, maintenance shall be conveniently and accessible located with reference to the finished building.
- D. Where wall and ceiling access doors are required, but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.
- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

1.18 COORDINATION OF TRADES:

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

1.19 GUARANTEES:

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item, and any other damage caused to the building free of charge to the Owner, including cost of labor and materials.
- B. Guarantee included in this section to cover:

1. Faulty or inadequate design of equipment or material installed
 2. Improper assembly or erection
 3. Defective workmanship or material
 4. Incorrect or inadequate operation or other failure
- C. The Contractor shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise
- D. Furnish the parts and labor to replace any items found to be defective in the refrigeration equipment with the guarantee period
- E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.
- F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty and proof of shipment date or purchase date per terms of warranty to the Owner, who shall be named as beneficiary.

1.20 PROTECTION OF EQUIPMENT AND MATERIALS:

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

1.21 CLOSING-IN OF UN-INSPECTED WORK:

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

1.22 BUILDING FOOTING CLEARANCES:

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

1.23 DAMAGE BY LEAKS:

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

1.24 EQUIPMENT LABELS:

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

1.25 EXCAVATION, TRENCHING AND BACK FILLING:

- A. Excavating, trenching and back filling for utilities within the building area shall be done in conformity with Division 31 - Site work. Piping shall be installed promptly after excavation in order to keep the trenches open as short a time as possible.
- B. Excavating, trenching and back filling for utilities outside the building area shall be done in conformity with Division 31 - Earth work.
- C. Any existing underground piping and conduit that is encountered shall be properly shored and protected from damage. Active piping shall be left intact and undamaged.

1.26 PRELIMINARY OPERATION:

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

1.27 MAINTAINING EXISTING SERVICES:

- A. The premises and existing building at the site will be in use at the time the work of this Section is in progress. Contractor shall conduct his work so as to cause no inconvenience or danger to the personnel on the premises.
- B. He shall maintain continuity of service to the existing mechanical systems, except for designated intervals during which connections can be made. The scheduling of the shut down period shall be at a time directed by the Architect.
- C. In some instances, it may be necessary to defer work in certain areas and locations until such time as existing facilities can be relocated or rearranged by the Owner. Therefore, whenever it becomes necessary for the Contractor to perform work under this contract in areas in which the Owner's work is being performed. This contractor shall advise the

Architect relative to this requirement and shall follow closely the directive issued by the Architect insofar as time and procedure are concerned. Allow Owner 72 hours prior notice.

- D. This contractor shall include in his bid all premium time to which he may be subjected for performing work in such procedure and at such time as may be necessary to cause the least interference with the function of the Owner.

1.28 ELECTRICAL WORK:

- A. Coordinate with Division 26 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.
- B. Voltage for electrical work will be included in Division 26. However, any control wiring which is required that is not shown on the control diagram shall be as described under this Section. In the event that the Contractor chooses to provide equipment that requires extra expense in the power or control wiring, he shall pay additional electrical costs.
- C. Safety switches, starters, circuit breakers, unless provided as a portion of package equipment, and the electrical connections of mechanical equipment to the electrical power service shall be provided under Division 26.
- D. Interconnecting wiring, safety switches, relays, controllers and motor starters which are integral components of packaged equipment shall be provided as an integral part of that equipment.
- E. All interconnecting power wiring and conduits shall be provided by Division 26.
- F. Control wiring shall be provided by Division 22, unless otherwise indicated on the drawings.
- G. Conduit for control wiring shall be provided by Division 26.

END OF SECTION

SECTION 22 05 16
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

1.2 REFERENCE STANDARDS:

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.

1.3 SUBMITTALS:

A. Product Data:

- 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS - STEEL PIPING:

A. Manufacturers:

- 1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.

2.2 FLEXIBLE PIPE CONNECTORS - COPPER PIPING:

A. Manufacturers:

- 1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
- 2. The Metraflex Company; _____: www.metralflex.com/#sle.

2.3 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE:

A. Manufacturers:

- 1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.

2.4 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE:

A. Manufacturers:

1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.

2.5 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR:

A. Manufacturers:

1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.

2. The Metraflex Company; _____: www.metraflex.com/#sle.

B. Body Construction: Nylon-reinforced rubber tube.

C. End Connections: Carbon steel flanges.

D. Cover and Tube Elastomer: EPDM and EPDM.

E. Maximum Elongation: 3/8 inch.

F. Maximum Angular Movement: 15 degrees.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install in accordance with manufacturer's instructions.

B. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION SUBMITTALS:

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

PART 2 - PRODUCTS

2.1 SLEEVES:

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS:

- A. Manufactures: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 1. Advance Products & Systems, Inc
 2. CALPICO, Inc
 3. Metraflex Company
 4. Pipeline Seal and Insulator, Inc

5. Proco Products, Inc

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT:

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION:

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements for fire stopping specified in Section 078413 "Penetration Fire stopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION:

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE:

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller than NPS 6 (DN 150): Cast-iron wall sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

- a. Piping Smaller than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

- a. Piping Smaller than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
- b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

- a. Piping Smaller than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
- b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 SUBMITTALS:

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS:

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES:

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL:

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.

1.2 ACTION SUBMITTALS:

- #### A. Product Data:
- For each type of valve indicated.

1.3 QUALITY ASSURANCE:

- #### A. ASME Compliance:
- ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- #### B. NSF Compliance:
- NSF 61 for valve materials for potable-water service.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES:

- A. Refer to valve schedule articles for applications of valves.
- B. Valves shall be provided on all supplies to equipment and fixtures.
- C. Obtain each type of valve from single source from single manufacturer.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
- H. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With 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: With extended neck.
- I. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES:

- A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Design: One piece.
- d. Body Material: Forged brass.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Brass.
- h. Ball: Chrome-plated brass.
- i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 400 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded or Solder.
- g. Seats: PTFE or TFE.

- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.3 BRONZE BALL VALVES:

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.

- e. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or Solder.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass or Stainless Steel.
 - j. Port: Full.

2.4 BRONZE SWING CHECK VALVES:

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.

- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES:

A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO, INC
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, nickel iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.
 - i. Disc: ASTM A351.
 - j. Gasket: Asbestos free.

2.6 BRONZE GATE VALVES:

A. Class 125, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.

- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Stainless Steel.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig (1380 kPa).

- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Stainless Steel.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION:

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Shut-off valves shall be provided in main branches, runs to risers and where indicated on drawings
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install on operators for butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
 - 1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 ADJUSTING:

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS:

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: ball, or butterfly valves.
 - 3. Pump-Discharge Check Valves:

- a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
 - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
- 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE:

- A. Pipe NPS 2 (DN 50) and Smaller:
- 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
 - 5. Bronze Gate Valves: Class 125, NRS.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
- 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to NPS 100): May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron Gate Valves: Class 125 OS&Y.
6. Iron Globe Valves: Class 125.

3.5 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE:

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to NPS 100): May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
4. Iron Gate Valves: Class 125, OS&Y.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS:

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
 4. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying and undue strain.
 5. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

1.3 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS:

- A. Welding certificates.

1.5 QUALITY ASSURANCE:

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS:

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS:

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts. The total load of piping components imposed on trapeze spans shall not exceed manufacturer's design load rating. Load calculation and detail of each unit shall include a safety factor of two times the expected load.

2.3 THERMAL-HANGER SHIELD INSERTS:

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS:

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS:

- A. General Requirements for Pipe Stands: shop or field fabricated assemblies made of manufactured corrosion-resistant components of support roof-mounted piping.
- B. Compact pipe stand:
 - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - 3. Hardware: Galvanized steel or polycarbonate.
 - 4. Accessories: Protection pads.
- C. Single-Base, Single-Pipe Stand:
 - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - 3. Vertical Members: Two galvanized steel, continuous thread, 1/2 inch rods.
 - 4. Horizontal Member: Adjustable horizontal, galvanized steel pipe support Channel.
 - 5. Pipe Supports: Roller
 - 6. Hardware: Galvanized steel
 - 7. Accessories: Protection pads.

2.6 PIPE POSITIONING SYSTEMS:

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS:

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

2.8 ACOUSTICAL NOISE AND VIBRATION ISOLATION:

- A. Acoustical Isolation System: Consisting of loop hangers, J-hangers, through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material, associated support bracket, and fire stop sleeve devices. For applications requiring acoustical isolation of tubing, piping, and equipment from building elements, such as floors, walls, and framing members.

2.9 MISCELLANEOUS MATERIALS:

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Stainless Steel: ASTM A240/A240M.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION:

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:
 - 1. Pipe Stand Types: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- O. Protect tubing and piping from damage caused by abrasion when passing through studs, joist, and similar framing using abrasion protection isolators.
- P. Prevent damage to piping and tubing caused by contact between dissimilar metals using insert system designed specifically for this application.

3.2 EQUIPMENT SUPPORTS:

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

3.3 METAL FABRICATIONS:

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING:

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING:

- A. Touch up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touch up: Cleaning and touch up painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting." And Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE:

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

PART 1 - PRODUCTS

1.1 CABLE OUTER JACKET MARKINGS:

- A. Name of manufacturer, trademark, or other recognized symbol of identification.
- B. Catalog number, reference number, or model.
- C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
- D. Agency listing or approval.

1.2 CONNECTION KITS:

- A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
- B. Provide with NEMA 4X rating for prevention of corrosion and water ingress.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.2 RELATED REQUIREMENTS:

- A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS:

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.4 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: For each type of product indicated, provide manufacturer's standard product data sheets. Data sheets must detail compliance with applicable standards for color and size and clearly define durability of no less than 4 years.

PART 2 - PRODUCTS

2.1 PLUMBING COMPONENT IDENTIFICATION GUIDELINE:

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

2.2 MANUFACTURERS:

- A. Brady Corporation: www.bradycorp.com.
- B. Champion America, Inc: www.Champion-America.com.
- C. Seton Identification Products: www.seton.com/aec.

2.3 NAMEPLATES:

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
3. Seton Identification Products: www.seton.com.

B. Description: Laminated piece with up to three lines of text.

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving minimum 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Letter Height: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 200 deg F.

C. Equipment Nameplate Content: Each nameplate shall include equipment's Drawing designation or unique equipment number, consistent with the drawings.

2.4 TAGS:

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Brimar Industries, Inc: www.pipemarker.com.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
5. Seton Identification Products: www.seton.com.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges. The content of each tag shall include a 1/4 inch top-line abbreviation identifying the system Terminology shall match drawings. Content, second line shall include a unique sequential 1/2 inch number to identify the valve.

C. Tag Material: Brass, 0.032 inch or stainless steel 0.032 inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

D. Fasteners: Brass or stainless steel S-hook.

2.5 STENCILS:

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. Seton Identification Products: www.seton.com.

B. Stencils shall be identified as indicated below including direction of flow

1. Gravity Condensate - G.C.
2. Domestic Cold Water - D.C.W.
3. Domestic Hot Water - D.H.W.
4. Domestic Hot Water Return - D.H.W.R.

C. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

D. Stencil Ink: Interior stencil ink shall be compatible with interior surfaces and finishes.

2.6 PIPE MARKERS:

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com/.
2. Craftmark Pipe Markers: www.craftmarkid.com.
3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements for Manufactured Pipe Labels: Identify the content and directional flow of piping systems. Whenever possible select manufacturers standard preprinted, color-coded, pipe markers. Pipe marker sizes and colors shall comply with ANSI / ASME A13.1.

C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

2.7 CEILING TACKS:

A. Manufacturers:

1. Craftmark: www.craftmarkid.com.
2. Brady Corporation: www.bradycorp.com.
3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Steel with 3/4 inch diameter color coded head.

C. Color code as follows:

1. Plumbing Valves: Green.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints and encapsulate.

3.2 INSTALLATION:

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Install tags in clear view and align with axis of piping
- E. Identify valves in main and branch piping with tags.
- F. Identify piping, concealed or exposed, with stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Flexible elastomeric cellular insulation.
- B. Glass fiber insulation.
- C. Jacketing and accessories.
- D. Insulating Covers for Accessible Lavatory / Sink Piping

1.2 REFERENCE STANDARDS:

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness. Inspect for damage.
- B. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- C. Protect insulation from damage by securing areas and by leaving factory packaging in place until usage.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS:

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or ASTM E84.
- B. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASME C81.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

2.2 FLEXIBLE ELASTOMERIC CELLULAR INSULATION:

- A. Manufacturers:
 - 1. Aeroflex USA, Inc: www.aeroflexusa.com.
 - 2. Armacell LLC: www.armacell.us.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation containing antimicrobial additive complying with ASTM C534/C534M Type I; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.

2.3 JACKETING AND ACCESSORIES:

A. Aluminum Jacket:

1. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.4 TAPES:

A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers:

- a. 3M Industrial Adhesives and Tapes Division.
- b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches

3. Thickness: 3.7 mils

4. Adhesion: 100 ounces force/inch in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces: free of voids throughout the length of piping, including fittings, valves, and specialties.
- D. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Exposed Piping: Locate insulation and cover seams in least visible locations.

- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- I. Install insulation on piping accessories requiring future re-occurring access and service with factory fabricated insulation covers that are easily removed and reapplied
- J. Inserts and Shields:
 - 1. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 2. Insert Location: Between support shield and piping and under the finish jacket.
 - 3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- K. Continue insulation through walls, roof, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- N. Install manufactured preformed insulating cover around hot-water supplies, and cold-water supplies including supply stops, butted up to bottom surface of lavatory / sink, or up inside between wall and upper lavatory / sink cavity. ensure a straight precision cut fit and finish.
- O. Install manufactured preformed insulating cover around trap and tubing, including all drainage piping, butted up to bottom surface of lavatory and over escutcheon wall trim. Ensure a straight precision cut fit and finish.
- P. Secure all covers with fasteners provided. Do not use cable tie fasteners, adhesives, or adhesive tapes for attachments. Do not use adhesives as a component to support the fastening system.
- Q. Do not use adhesives in any part of the method of construction of the insulation coverings.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet of building.
- D. Domestic water piping, above grade.
- E. Storm drainage piping, buried within 5 feet of building.
- F. Sanitary sewer and vent.
- G. Pipe flanges, unions, and couplings.

1.2 REFERENCE STANDARDS:

- A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- B. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- H. ASME B31.1 - Power Piping; 2024.
- I. ASME B31.9 - Building Services Piping; 2020.
- J. 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; 2023.

- K. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- M. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- N. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- O. ASTM B32 - Standard Specification for Solder Metal; 2020.
- P. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- R. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- S. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- T. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- U. ASTM C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings; 2022.
- V. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- W. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- X. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- Y. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2022.
- Z. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2022.
- AA. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- BB. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings; 2021.

- CC. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- DD. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2020.
- EE. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- FF. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core; 2023.
- GG. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).
- HH. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- II. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- JJ. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- KK. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
- LL. AWWA C606 - Grooved and Shouldered Joints; 2022.
- MM. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.
- NN. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- OO. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- PP. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- QQ. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- RR. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
- SS. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- TT. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

UU.ASME - Boiler and Pressure Vessel Code

VV.AGA - American Gas Association Code

1.3 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Valve Repacking Kits: One for each type and size of valve.

1.4 QUALITY ASSURANCE:

- A. Perform Work in accordance with State of California, standards.
 - 1. Maintain one copy on project site.
- 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.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX. Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.
- E. Piping materials shall bear label, stamp, or other markings for specified testing agency.

1.5 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.
- E. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.
- F. Protect and store PE pipes and valves from direct sunlight.

- G. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations. Replace all damaged or defective items.

1.6 FIELD CONDITIONS:

- A. Do not install underground piping when bedding is wet or frozen.
- B. Interruption of Existing Utility Service: Do not interrupt service to facilities occupied by owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.
- C. Become familiar with details of the scope of work, verify dimensions in the field, and advise the Architect / Engineer of any discrepancy prior to performing any work.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 14, NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Sanitary Waste and Vent Systems: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "FSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

2.2 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING:

- A. ABS Pipe: ASTM F628, Schedule 40.
 - 1. ABS Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste and vent patterns.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
 - a. Solvent cement shall have a VOC content of 325 g/L or less.
 - b. Solvent cement shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and

Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 SANITARY SEWER AND VENT PIPING, ABOVE GRADE:

- A. Cast Iron Pipe: ASTM A888, CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron, ASTM A888 or CISPI 301.
 - 2. Sovent Stack fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aearator and deaerator drainage fittings.
 - 3. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
 - 4. CISPI, Hubless-Piping Couplings:
 - a. Standards: ASTM C 1277 and CISPI 310.
 - b. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices: and ASTM C 564, rubber sleeve with integral, center pipe stop.
 - 5. Cast-Iron, Hubless-Piping Couplings:
 - a. Standards: ASTM C 1277 and ASTM C 1540.
 - b. Description: Stanless-steel shield with stainless-steel bands and tightening devices: and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING:

- A. Copper Pipe: Class 150 bronze unions with brazed joints below grade, hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Copper Unions:
 - a. MSS SP-123
 - b. Cast-copper-alloy, hexagonal-stock body.
 - c. Ball-and-socket, metal -to-metal seating surfaces.
 - d. Solder-joint or threaded ends.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE:

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.
3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Anvil International: www.anvilintl.com/#sle.
 - 2) Apollo Valves: www.apollovalves.com/#sle.
 - 3) Grinnell Products: www.grinnell.com/#sle.
 - 4) Viega LLC: www.viega.us/#sle.

2.6 PIPE FLANGES, UNIONS, AND COUPLINGS:

A. Unions for Pipe Sizes 3 inch and Under:

1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.
2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron, galvanized.
3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

C. No-Hub Couplings:

1. Testing: In accordance with ASTM C1277 and CISPI 310.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.

D. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
2. Sealing gasket: "C" shape composition sealing gasket.

PART 3 - EXECUTION

3.1 EXAMINATION:

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

3.2 PREPARATION:

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Shut-off valves shall be provided on all main branches, runs to risers and where shown on drawings. Locate shut-off valves over T-Bar Ceiling when possible. Provide access panels when shut-off valves are located over hard lid ceilings.
- I. Provide access where valves and fittings are not exposed.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Color to be specified by architect.
- K. Exposed, unfinished pipe, fittings, supports, and accessories shall be painted.

- L. Exterior piping, fittings, supports and accessories shall have approved UV protection
- M. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- N. Provide stem extension on all valves for piping requiring insulation to ensure valve can be cycled without damaging pipe insulation.
- O. Install water piping to ASME B31.9.
- P. 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.
- Q. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.4 APPLICATION:

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install globe valves for throttling, bypass, or manual flow control services.
- E. Provide spring-loaded check valves on discharge of water pumps.
- F. Provide flow controls in water recirculating systems where indicated.

3.5 FIELD TESTS AND INSPECTIONS:

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:

1. Perform hydrostatic testing for leakage prior to system disinfection.
2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
3. General:
 - a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM:

- A. Disinfect water distribution system in accordance with local jurisdiction. Potable water systems shall be disinfected and flushed prior to use by water-chlorination solution and have bacteriological examination made by an approved agency per 2019 California Plumbing Code section 609.9 and as prescribed in AWWA C651. Methods of cleaning / disinfecting for new or repair piping as described in C651 or NFPA 24.
- B. Prior to starting work, verify system is complete, flushed, and clean.

3.7 INSTALLATION OF FLOW CONTROL VALVES:

- A. Install automatic flow control valve in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each automatic flow control valve.
- B. Set flow control valve flow rate as follows:
 1. Preliminary Procedures For Hot Water Return System Balancing:
 - a. Before operating the system perform these steps:
 - 1) Open Valves at recirculation pump and flow control valves to full open position.
 - 2) Remove and clean all strainers.
 - 3) Check recirculation pump rotation.
 - 4) Set water heater temperature as indicated on the drawings.
 2. Procedures For Hot Water Return System Balancing:
 - a. Refer to the drawings for required flow rate for each flow control valve.

- b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.
 - c. Apply instrument as recommended by the manufacturer.
 - d. Take readings with the eye at the level of the indicated valve to prevent parallax.
 - e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
 - f. Retest, adjust, and balance systems subsequent to significant systems modifications, and resubmit test results.
- C. Reports: Prepare hot water return system balancing reports signed and submit to the architect upon completion of the project. Include the following information:
- 1. Valve tag number and description of location
 - 2. Valve body size
 - 3. Differential pressure reading from instrument in psi
 - 4. Actual flow rate derived from the manufacturer's charts and tablets for the valve size and measured differential pressure.

3.8 SERVICE CONNECTIONS:

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
- 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Backflow preventers.
- E. Trap Primer
- F. Mixing valves.
- G. Exterior penetration accessories.
- H. Fire-rated enclosures.
- I. Flexible connectors.

1.2 REFERENCE STANDARDS:

- A. ASME A112.6.3 - Floor Drains; 2022.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.
- E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- F. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies; 2021.
- G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
- I. NSF 372 - Drinking Water System Components - Lead Content; 2022.

J. PDI-WH 201 - Water Hammer Arresters; 2017.

1.3 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Certificates: Certify that grease interceptors meet or exceed specified requirements.

1.4 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Accept specialties on site in original factory packaging. Inspect for damage.
- B. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations. Replace all damaged or defective items.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS:

A. Manufacturers:

- 1. Josam Company: www.josam.com.
- 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
- 3. Zurn Industries, LLC: www.zurn.com.
- 4. Mifab: www.mifab.com

B. Drain Assemblies

- 1. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

C. Floor Sink:

- 1. Standard: ASME A112.6.7

2. Description: Cast iron 8 inch square, 6 inch deep flanged receptor with seepage holes, loose set acid resistant coated cast iron grate.
3. Body: Cast iron with acid-resistant coated interior.
4. Outlet: Bottom no-hub, refer to drawings for size.
5. Strainer: Aluminum dome.
6. Trap Primer: 1/2 inch connection.
7. Grate Coverage Area: Half grate

2.3 CLEANOUTS:

A. Cast-Iron Cleanout

1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - b. Josam Company: www.josam.com.
 - c. Zurn Industries, LLC: www.zurn.com.
 - d. Mifab: www.mifab.com
2. Standard: ASME A 112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Frame and Cover: Round, stainless steel

2.4 HOSE BIBBS:

A. Manufacturers:

1. Woodford: www.woodfordmfg.com.
2. Zurn Industries, LLC: www.zurn.com.
3. Mifab: www.mifab.com

B. Recessed Hose Bibbs:

1. Standard: ASME A112.18.1.

2. Description: Wall mounted hose bibb with lockable recessed box, chrome plated with metal hand wheel and operating tee key.
3. Body Material: Bronze with chrome finish
4. Supply Connections: 3/4 inch.
5. Vacuum Breaker: Integral, non-removeable, hose-connection vacuum breaker complying with ASSE 1011.
6. Recessed Box: Brass or chrome lockable box.

2.5 BACKFLOW PREVENTERS:

A. Manufacturers:

1. Conbraco Industries, Inc: www.apollovalves.com.
2. Watts Regulator Company, a part of Watts Water Technologies : www.wattsregulator.com.
3. Zurn Industries, LLC: www.zurn.com.

B. Reduced Pressure Backflow Preventer Assembly:

1. Standard: ASSE 1013.
2. Operation: Continuous pressure applications.
3. Pressure Loss: 13 psi maximum, through middle third of flow range.
4. Size: Refer to plans.
5. Body: 2 inches and smaller bronze body assembly, 2-1/2 inches and larger a stainless steel body. All sizes with corrosion resistant internal parts and stainless steel springs.
6. End Connections: Threaded full port ball valves for 2 inches and smaller, flanged gate valves for 2-1/2 inches and larger.
7. Size: assembly with threaded gate valves.
8. Accessories:
 - a. Valves 2 inches and smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves 2-1/2 inches and larger: Outside screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air gap fitting, lead-free Y-strainer, and test cocks.

2.6 TRAP PRIMERS:

A. Manufacturers:

1. Precision Plumbing Products: www.pppinc.com.
2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
3. Mifab: www.mifab.com

B. Electronic Trap Primer

1. Description: Electronic Trap Primer floor drain trap priming device consisting of a solenoid valve, bronze air gap fitting, 3-prong cord, and timer factory set to discharge once every 24 hour period. Add EMS to interface with the facility's energy management system as required. Conforms to UL and CSA Standards. Installed to manufacturer's recommendations.
2. Standard: ASSE 1044.
3. Cabinet: All concealed trap primers shall be accessible by means of access door or removable panel. Recessed -mounted steel box with stainless-steel cover.
4. Inlet and Outlet size: 1/2 inch threaded or solder joint.

2.7 MIXING VALVES:

A. Thermostatic Master Mixing Valves:

1. Manufacturers:
 - a. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com.
 - b. POWERS, a WATTS brand: www.watts.com/our-story/brands/powers.
 - c. Symmons Industrie, Inc.: www.symmons.com.
 - d. Leonard Valve Company: www.leonardvalve.com.
 - e. Bradley Corporation: www.bradlycorp.com.
2. Construction:
 - a. Standard: ASSE 1017
 - b. Pressure Rating: 125 psig.
 - c. Type: Therostatically controlled, water mixing valve.

- d. Material: Bronze body with corrosion-resistant interior components.
- e. Connections: Threaded inlets and outlet.
- f. Accessories: Check stops on hot-and cold water supplies, and adjustable, temperature control handle.
- g. Tempered-Water Setting: 110 deg F unless stated otherwise on plans.
- h. Inlet / Outlet Connections: Refer to plans for sizes, provide ball valves.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for prodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- E. Pipe relief from backflow preventer to nearest drain.
- F. Install water hammer arrestors complete with accessible isolation valve on supply piping.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Water heaters.
 - 1. Tank electric.
 - 2. Point-of-use electric.
- B. Diaphragm-type compression tanks.
- C. In-line circulator pumps.

1.2 REFERENCE STANDARDS:

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014 (Reaffirmed 2020).
- C. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space; 2017.
- D. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).
- E. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.
- F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).

1.3 SUBMITTALS:

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Provide electrical characteristics and connection requirements.

- B. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE:

PART 2 - PRODUCTS

2.1 WATER HEATERS:

A. Tank Electric:

1. Manufacturers:
 - a. Bradford White Corporation: www.bradfordwhite.com.
 - b. Rheem Manufacturing Company: www.rheem.com.
 - c. AO Smith: www.hotwater.com.
2. Type: Factory-assembled and wired, electric, vertical storage.
3. Standard: UL 1453.
4. Tank Construction: Non-ASME-Code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - i. NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - ii. NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Electrical Characteristics: Refer to schedules on plan sheets.
6. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve: Corrosion-resistant metal with hose-end connection.
 - d. Anode: Replaceable Magnesium.

- e. Jacket: Steel with enameled finish or high-impact composite material.
 - f. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - g. Temperature and Pressure (T&P) Relief Valve: The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 59 kW 200,000 Btu shall have a 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW 200,000 Btu shall have 1 inch minimum inlet, and 1 inch outlet. The discharge pipe from the relief valve shall be the size of the valve outlet.
7. Temperature Control: Adjustable thermostat with ranges to include 90 to 180 degrees Fahrenheit. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. Automatic reset high temperature limiting thermostat factory set at 195 degrees Fahrenheit. Flanged or screw-in nichrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.

B. Electric Point-Of-Use:

- 1. Manufacturers:
 - a. Chronomite: www.chronomite.com
 - b. Eemax Inc.: www.eemax.com

2.2 EXPANSION TANK:

A. Manufacturers:

- 1. Watts: www.watts.com
- 2. Amtrol: www.amrtol.com

B. Construction: Steel pressure-rated tank constructed with welded joints and factory installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

- 1. Tapings: Factory-fabricated steel, welded to tank before testing and lagging. Include ASME B1.20.1 pipe thread.

2. Interior Finish: Comply with NSF 61 and NSF372 barrier materials for potable water tank linings, including extending finish into and through tank fittings and outlets.
3. Air-Charging Valve: Factory installed.

C. Capacity: Refer to schedule on plan sheets for capacity information.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.
- B. Coordinate system, equipment, and piping work with applicable electrical, fuel, gas, vent, drain, and waste support interconnections as included or provided by other trades.
- C. Pumps:
 1. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.2 SCHEDULES - SEE SHEET P-B002.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 DESCRIPTION:

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

1.3 WORK INCLUDED:

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

13. Record drawings.

14. Guarantee

1.4 WORK SPECIFIED ELSEWHERE:

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

1.5 SITE INSPECTION:

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

1.6 ORDINANCES, REGULATIONS AND CODES:

- A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.

- 1. AFI - Air Filter Institute
- 2. AMCA - Air Moving & Conditioning Association
- 3. ARI - Air Conditioning & Refrigeration Institute
- 4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
- 5. ASME - American Society of Mechanical Engineers
- 6. ASTM - American Society of Testing Materials
- 7. AWS - American Welding Society Code
- 8. ANSI - American National Standards Institute
- 9. CBC - California Building Code
- 10. CCR - California Code of Regulations
- 11. CEC - California Electrical Code
- 12. CFC - California Fire Codes
- 13. CMC - California Mechanical Code

14. CPC - California Plumbing Code
 15. FIA - Factory Insurance Association
 16. NAFM - National Association of Fan Manufacturers
 17. NEMA - National Electrical Manufacturer's Association
 18. NFPA - National Fire Protection Association
 19. ORS - Office of Regulatory Services
 20. SCAQMD - South Coast Air Quality Management District
 21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
 22. UFC - Uniform Fire Code
 23. UL - Underwriter's Laboratories
 24. UPC - Uniform Plumbing Code
- B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.
- C. Codes and Standards:
1. IBC and California Amendments (California Building Code - Part 2, Title 24, CCR).
 2. UMC and California Amendments (California Mechanical Code - Part 4, Title 24 CCR).
 3. UPC and California Amendments (California Plumbing Code - Part 5, Title 24 CCR).
 4. Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24 CCR).
 5. National Fire Protection Associations - National Fire Code.
- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.

- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.7 PERMITS, FEES AND INSPECTIONS:

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

1.8 DRAWINGS AND SPECIFICATIONS:

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

1.9 SUBMITTALS:

- A. Before starting work, the Contractor shall furnish for the approval of the Architect, Shop Drawings and Submittals with Itemized Equipment Lists, complete in all details that they proposes to install. All items shall be submitted at the same time.
- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.
- C. Variations or deviations on submitted items from that specified must be clearly tagged and / or identified
- D. Submittals shall include, but not necessarily be limited to the following which are mandatory:

1. Draw Equipment Layouts to 1/4" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
2. Schedule of pipe, fittings, valves, with manufacturer and catalog number.
3. Specialties, valves, gauges and thermometers of all types.
4. Foundations, supports, hangers, inserts.
5. Earthquake supports and calculations.
6. Insulation.
7. Ventilation and air conditioning equipment, specialties and the air control systems.
8. Fans, fan characteristic curves, fan tests.
9. Dampers, louvers, grilles, registers, diffusers.
10. Shop fabrication drawings and installation drawings of ductwork and piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping and ductwork to finish floor level.
11. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
12. Automatic control system diagrams.
13. Exhaust, supply and return fans.
14. Access panels.
15. Hangers, inserts, supports, anchors.
16. Pipe, fittings and specialties.
17. Pipe isolators.
18. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
19. Expansion joints, guides and anchors.
20. Shop fabrications drawings and calculations.
21. Special and miscellaneous products furnished under this section and not listed herein.

1.10 RECORD DRAWINGS AND MANUALS:

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved

submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.

- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 01 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
 - 1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 - 2. Specifications
 - 3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 - 4. Grouting requirements.
 - 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.
 - 6. Start-up and beginning operation procedures.
 - 7. Operational procedures.
 - 8. Shutdown procedures.
 - 9. Maintenance and calibration procedures
 - 10. Parts lists
 - 11. Name, address and telephone number of each manufacturer's local representative.

- H. Manual Submittals: Unless otherwise specified, each submittal shall include two copies of each manual, one of which will be returned to the Contractor, marked to show the required review. When approved, deliver four copies to Architect unless otherwise specified.
- I. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided prior to commencement of air and water balance.

1.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP:

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

1.12 SEISMIC DESIGN:

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure including calculations for approval by structural engineer or for approval by inspector of record, as applies, for items or work, where approval is deferred or where alternate support or anchorage detail is proposed to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. The anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. (Building equipment and connections therefore shall be designed to resist lateral seismic forces equal to 1.0 of equipment weight to working allowable stress. Cantilever posts supporting equipment shall be designed to resist lateral seismic forces equal to 0.5 of equipment weight to allowable working stress. Conform to the following:
 - 1. In accordance with Title 24, 2019 CBC Chapter 16A, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
 - 2. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2019 CBC Chapter 16A. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

1.13 SUBSTITUTIONS AND CHANGES:

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

1.14 SUBMITTAL REVIEWS:

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

1.15 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS:

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

1.16 LOCATIONS AND ACCESSIBILITY:

- A. Drawings show pipe and ductwork diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences as reviewed by Architect and / or Engineer. Install piping and ductwork to best suit field conditions after coordinating with other trades. Run exposed piping and ductwork parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.

- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, cleanouts, dampers, controls, steam and water specialties, duct access doors or any other indicating equipment or specialties requiring reading, adjustment, inspection, maintenance shall be conveniently and accessible located with reference to the finished building.
- D. Where wall and ceiling access doors are required but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.
- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

1.17 COORDINATION OF TRADES:

- A. Contractor shall coordinate all trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit, and ducts and to maintain maximum headroom and accessibility.
- B. No extras will be allowed for changes made necessary by interference or coordination between trades.
- C. Submit Composite Coordination Drawings in accordance with Submittal Procedures. Include dimensioned plans, elevations, sections and details and give complete information particularly as to the kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, lighting, structural interferences. Coordinate these Composite Coordination Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervision of field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified in Division 01. Do not start installation of work involved under Composite Coordination Drawings until the Architect reviews applicable submittal. Discrepancies between the Drawings and Composite Coordination Drawings shall be specifically noted and identified on the Composite

Coordination Drawings. Drawings for the various trades involved shall be submitted as required and reviewed prior to preparation of Composite Coordination Drawings.

1. Equipment Foundations and Bases: Furnish certified details and drawings for approval before fabrication. Furnish parts necessary for each foundation subbase and support.
2. Pipe Sleeves and Inserts: Furnish and install pipe sleeves and pipe support inserts before concrete is poured.
3. Roof, Wall and Floor Openings: Furnish Shop Drawings showing exact locations and sizes of openings through roofs, walls and floors.
4. Concrete: Conform to Concrete Section of the Specifications.

1.18 GUARANTEES:

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item and any other damage caused to the building free of charge to the Owner, including cost of labor and materials.
- B. Guarantee included in this section to cover:
 1. Faulty or inadequate design of equipment or material installed
 2. Improper assembly or erection
 3. Defective workmanship or material
 4. Incorrect or inadequate operation or other failure
- C. The contractor shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise
- D. Furnish the parts and labor to replace any items found to be defective in the mechanical equipment with the guarantee period.
- E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.
- F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty and proof of shipment date or purchase date per terms of warranty to the Owner, who shall be named as beneficiary.

1.19 PROTECTION OF EQUIPMENT AND MATERIALS:

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

1.20 CLOSING-IN OF UNINSPECTED WORK:

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

1.21 BUILDING FOOTING CLEARANCES:

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

1.22 DAMAGE BY LEAKS:

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

1.23 EQUIPMENT LABELS:

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

1.24 PRELIMINARY OPERATION:

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

1.25 ELECTRICAL WORK:

- A. Coordinate with Division 26 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.

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

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following hangers and supports for mechanical system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
3. Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.
4. Division 23 Section "Pipe Expansion Fittings and Loops" for flexible pipe.
5. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS:

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

1.3 PERFORMANCE REQUIREMENTS:

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

1.4 SUBMITTALS:

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

1.5 QUALITY ASSURANCE:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS:

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

2.3 TRAPEZE PIPE HANGERS:

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

2.4 METAL FRAMING SYSTEMS:

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

2.5 THERMAL-HANGER SHIELD INSERTS:

- A. Description: 100-psig-minimum, compressive-strength insulation inserts encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS:

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

2.7 PIPE STAND FABRICATION:

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

- 4. Horizontal Member: Protective-coated-steel channel.
- 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS:

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

2.9 EQUIPMENT SUPPORTS:

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

2.10 MISCELLANEOUS MATERIALS:

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

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS:

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

- F. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members notching. Provide such members with reinforcement steel straps of Kees Protecta-Plate or equal.
- G. For fastening to wood rafters and beams, or joists, furnish Grinnell figure 128 or 202 or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2 inch x 2 inch x 1/4 inch angle clips 3 inches long, with 2 staggered 10d nails, clinched over joist.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 and larger, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 and larger.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.

- 2. Side-Beam Brackets (MSS Type 34): For sides of wooden beams.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION:

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Each trapeze pipe hanger requires submittal of calculations and details.
 - 2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
 - 1. Each metal framing system requires submittal of calculations and details.

- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Each pipe stand in requires submittal of calculations and details.
 - 2. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 3. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 for curbs specifications.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - 1. Each equipment support requires submittal of calculations and details.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- O. Insulated Piping: Comply with the following:

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

3.3 EQUIPMENT SUPPORTS:

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

3.4 METAL FABRICATIONS:

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

3.5 ADJUSTING:

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING:

- A. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Vibration-isolated equipment support bases.
- B. External seismic snubber assemblies.
- C. Seismic restraint systems.

1.2 REFERENCE STANDARDS:

- A. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. MFMA-4 - Metal Framing Standards Publication; 2004.
- D. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.3 DESIGN REQUIREMENTS:

- A. It is the intent of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit and to seismically restraint piping, ductwork and equipment per the applicable codes against seismic forces in any direction.
- B. All isolators shall:
 - 1. Be provided by a single manufacturer.
 - 2. Be designed or treated for resistance to corrosion. Structural steel bases shall be cleaned of welding slag and coated with an SCAQMD compliant primer.
 - 3. Be selected to perform their function without undue stress or overloading.
 - 4. All isolators shall have a method for leveling and have a 1/4" thick ribbed neoprene acoustical pad under the spring baseplate
 - 5. Be installed in a manner to prevent the transmission of vibration to the structure. No rigid connections between rotating or oscillating equipment or piping and the building will be permitted.

- 6. Be designed to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
 - C. Anchor floor mounted isolated equipment to concrete housekeeping pads of sufficient size to accommodate the anchorage of seismic restraints. Housekeeping pads shall be anchored to the structure as specified by the Structural Engineer of Record.
 - D. Each fan and motor assembly shall be supported on a single structural steel frame. Flexible duct connections shall be provided at inlet and discharge ducts.
 - E. Where called for in the specifications or on the drawings, all structural steel bases, including concrete pouring form bases, shall be designed and fabricated by the isolation manufacturer.
 - F. Unless otherwise indicated, all equipment mounted on vibration bases shall have a minimum operating clearance of 1" between structural steel base and floor or support base beneath. The minimum operating clearance between concrete inertia bases and housekeeping pads shall be 1 inch. Check clearance space after installation to ensure that no debris has been left to possibly short circuit isolation bases.
 - G. Where necessary due to height limitations, provide height saving brackets.
 - H. Design isolators for positive anchorage against uplift and overturning.
 - I. Purchased and/or fabricated equipment must be designed and manufactured with provision for positive anchorage against seismic forces.
 - J. Seismic restraints for pipes and ducts shall be as per the SMACNA Guidelines for seismic Restraint of Mechanical Systems.
 - K. Seismic restraints for equipment shall be designed to meet the criteria of the current California Code of Regulations.
- 1.4 THE MANUFACTURER OF VIBRATION ISOLATION AND SEISMIC CONTROL EQUIPMENT SHALL HAVE THE FOLLOWING RESPONSIBILITIES:
- A. Determine adequate vibration isolation and seismic restraint sizes and locations.
 - B. Provide piping and equipment isolation systems and seismic restraints as scheduled and/or specified.
 - C. Provide installation instructions and drawings to assure proper installation and performance.
- 1.5 SUBMITTALS:
- A. Product Data:

1. Provide manufacturer's product literature documenting compliance with PART 2 PRODUCTS.
2. Include seismic rating documentation for each isolator and restraint component accounting for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Specific vibration isolators and seismic restraints to be utilized showing compliance with the specifications.
2. Isolation frame construction for each machine including dimensions, structural member sizes, support points and restraint locations and details.
3. Methods for isolation and restraint of suspended piping, ductwork, and equipment.
4. Methods for guides and isolation of piping risers.
5. Seismic restraint calculations signed and stamped by an engineer licensed in the State of California and experienced in the design of isolation and seismic restraint for flexibly mounted equipment.
6. Fully dimensioned fabrication drawings and installation details for vibration isolation bases, member sizes, attachments to isolators, and supported equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. General:

1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
2. Steel springs to function without undue stress or overloading.

2.2 SEISMIC RESTRAINT SYSTEMS:

A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

B. Cable Restraints:

1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.

- 4. Use protective thimbles for cable loops where potential for cable damage exists.
- C. Rigid Restraints: Use MFMA-4 steel channel (strut) for structural element; suitable for both compressive and tensile design loads.
- D. Comply with:
 - 1. ASHRAE (HVACA) Handbook - HVAC Applications.
 - 2. SMACNA (SRM).
- E. Shall be capable of safely accepting external forces as specified in the applicable codes without failure. Restraints shall maintain equipment, duct, and piping in a captive position during an earthquake. Restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise under normal operating conditions. Seismic restraints shall be provided on all equipment as scheduled on the drawings. Submit calculations by a California registered engineer to verify snubber capacities.
- F. Type "3500" seismic restraint shall be constructed of steel plate, concentric steel pipes, and structural members in an all welded assembly. All contact points shall be cushioned with minimum 1/4" thick resilient pad.
- G. Type "3200" seismic restraint shall be all directional type with interlocking steel members constructed of structural angle and A-36 threaded rod. All contact points shall be cushioned with minimum 1/4" thick resilient pad or bushing.
- H. Type "CR" seismic restraints shall be constructed of 7x19 strand galvanized aircraft cable. Cable assembly shall come complete with minimum (2) "U" bolt clamps per end and thimbles to protect cable from chafing. Allowed loads shall be the cable breaking strength with a safety factor of three. Actual loads shall be calculated with the worst case of all load applied to one cable and anchor pattern. Cable shall be installed with 1/4" slack to prevent the transmission of vibration to the structure.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

3.2 INSTALLATION – GENERAL:

- A. Install in accordance with manufacturer's instructions.
- B. Vibration isolators must not be installed in a manner that will result in piping stress or misalignment.
- C. The structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment or isolators. The isolators shall be installed without raising the equipment and frame assembly.
- D. After the entire installation is complete and under full operational load, the isolator shall be adjusted so that the load is transferred from the blocks or shims to the isolator. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
- E. Once the equipment is in operation, install and anchor the seismic restraints with proper operating clearances as indicated on drawings.
- F. Mechanical equipment shall be isolated from the building structure by vibration isolators as scheduled on the drawings.
- G. All piping 1 1/4" and over located in mechanical equipment rooms, and for a minimum of fifty (50) feet or 100 pipe diameters whichever is greater, from connection to vibrating mechanical or electrical equipment, shall be isolated from the building structure by means of vibration isolators as identified above.
- H. All HVAC piping and vertical risers shall be isolated from the building structure by means of vibration isolators and guides.
- I. All piping and ductwork to be isolated shall freely pass through walls and floors without contact. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork and maintain adequate clearance around the outside surfaces. Any materials used to fill the clearance space shall be permanently flexible so that vibration will not pass through it.
- J. No rigid connections between equipment and building structure, including electrical conduit and refrigerant lines, shall be made that degrades the vibration isolation system herein specified. Inform other following trades, such as plastering, or electrical, to avoid any contact which would short-circuit the vibration isolation.
- K. Bring to the Architect's attention prior to installation any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

- L. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.
- M. Obtain inspection and approval of any isolation installation to be covered or enclosed, prior to such closure.
- N. Thrust restraints shall consist of spring hangers with the same deflection as specified for the spring mountings. Thrust restraints shall be attached to the fan at the centerline of air discharge opening.
- O. Correct, at no additional cost, all installations that are deemed defective in workmanship or materials.
- P. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
 - 1. Up to 4 Inches Pipe Size: First three points of support.
 - 2. 5 to 8 Inches Pipe Size: First four points of support.
 - 3. 10 inches Pipe Size and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.3 PIPING ISOLATORS:

- A. All piping except fire standpipe systems are included under this section.
- B. Isolate piping within 50 feet of rotating equipment and pressure reducing stations.
- C. The isolators shall be installed with the isolator hanger box attached to, or hung as close as possible to, approved locations on the supporting structure.
- D. The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically permitted.
- E. Hanger rods shall be aligned to clear the hanger box.
- F. Horizontal floor supported piping shall be isolated by type "RMLS-EQ", with a minimum static deflection of 1.0 inch or the same deflection as isolated equipment to which pipe is connected, whichever is greater.
- G. Vertical riser pipe support and restraint system shall consist of type "RMS" springs and type "PG-EQ" guides. Install vertical riser guides so that clearances are maintained around

concentric pipes in the guides. Install vertical restraints on the floor location as shown on drawings.

- H. Pipe anchors, where required, shall utilize resilient pipe anchors, type "RPA" or equivalent, to avoid direct contact of piping with building.
- I. Pipe Extension and Alignment connectors: Provide connectors at pump suction and discharge, riser take offs, cooling and heating coils, and elsewhere as required to accommodate thermal expansion and misalignment.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

- A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS:

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

1.4 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 - PRODUCTS

2.1 IDENTIFICATION APPLICATIONS:

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

2.2 NAMEPLATES:

- A. Manufacturers:

1. Advanced Graphic Engraving, LLC;
_____: www.advancedgraphicengraving.com/#sle.
2. Brimar Industries, Inc; _____: www.pipemarker.com/#sle.
3. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
4. Kolbi Pipe Marker Co; _____: www.kolbipipemarkers.com/#sle.
5. Letter Color: White.
6. Letter Height: 1/4 inch.
7. Background Color: Black.
8. Plastic: Comply with ASTM D709.

2.3 TAGS:

A. Manufacturers:

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

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

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

2.4 PIPE MARKERS:

A. Manufacturers:

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

B. Color: Comply with ASME A13.1.

- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Color code as follows:
 - 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
 - 2. Compressed Air: Blue with white letters.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 099123 for stencil painting.

3.2 INSTALLATION:

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 099123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Identify piping, concealed or exposed, with stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Commissioning activities.

1.2 REFERENCE STANDARDS:

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.3 SUBMITTALS:

- A. The contractor shall procure the services of an independent Air Balance and Testing Agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The independent agency shall be certified and in good standing with the AABC.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with Architect and other installers to sufficiently understand the design intent for each system.

5. Include at least the following in the plan:
- a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Expected problems and solutions, etc.
 - g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - h. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - l. Method of checking building static and exhaust fan and/or relief damper capacity.
 - m. Time schedule for deferred or seasonal TAB work, if specified.
 - n. False loading of systems to complete TAB work, if specified.

- o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - p. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - q. Procedures for formal progress reports, including scope and frequency.
 - r. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to the Commissioning Authority.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Progress Reports.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit to the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
 - 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.

- e. Project location.
- f. Project Architect.
- g. Project Engineer.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
 - 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. A minimum of two air balance test shall be completed for the project. One shall be completed prior to any demolition is made to test existing systems in scope of work. Second test shall begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Certified by the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION:

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
 12. Hydronic systems are flushed, filled, and vented.
 13. Pumps are rotating correctly.
 14. Proper strainer baskets are clean and in place.
 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES:

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

3.4 RECORDING AND ADJUSTING:

- A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner and / or project inspector.

3.5 AIR SYSTEM PROCEDURE:

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.02 inches negative static pressure in chemical storage rooms.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE:

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 COMMISSIONING:

- A. Perform prerequisites prior to starting commissioning activities.
- B. Include cost for commissioning requirements in the contract price.
- C. Attend commissioning meetings scheduled by the CxA when requested. TAB will need to be present 2 weeks prior to the start of TAB to review the TAB plan/procedures and weekly/bi-weekly during the on-site TAB work.
- D. Submit the TAB plan/procedures to the CxA for review at least two weeks prior to beginning TAB work.
- E. Notify the CxA a minimum of two weeks in advance of scheduled TAB work.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.
 - 1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 - 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as a Mechanical Acceptance Test Technician employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Participate in the Functional Performance Tests as required to achieve design intent.
- I. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- J. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for ____ percent of the air handlers plus a random sample equivalent to ____ percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:

- a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- K. In the presence of the Commissioning Authority, verify that:
- 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.8 SCOPE:

- A. Test, adjust, and balance the following:
- 1. Plumbing Pumps.
 - 2. HVAC Pumps.

3. Forced Air Furnaces.
4. Air Cooled Water Chillers.
5. Centrifugal Water Chillers.
6. Induced Draft Cooling Tower.
7. Blow Through Cooling Tower.
8. Air Cooled Refrigerant Condensers.
9. Packaged Roof Top Heating/Cooling Units.
10. Packaged Terminal Air Conditioning Units.
11. Unit Air Conditioners.
12. Computer Room Air Conditioning Units.
13. Air Handling Units.
14. Fans.
15. Air Filters.
16. Air Terminal Units.
17. Air Inlets and Outlets.

3.9 MINIMUM DATA TO BE REPORTED:

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Pumps:

1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

D. Combustion Equipment:

1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Firing rate.
5. Overfire draft.
6. Gas pressure at meter outlet.

7. Gas flow rate.
8. Heat input.
9. Burner manifold gas pressure.
10. Percent carbon monoxide (CO).
11. Percent carbon dioxide (CO₂).
12. Percent oxygen (O₂).
13. Percent excess air.
14. Flue gas temperature at outlet.
15. Ambient temperature.
16. Net stack temperature.
17. Percent stack loss.
18. Percent combustion efficiency.
19. Heat output.

E. Air Cooled Condensers:

1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Entering DB air temperature, design and actual.
7. Leaving DB air temperature, design and actual.
8. Number of compressors.

F. Chillers:

1. Identification/number.
2. Manufacturer.
3. Capacity.

4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.
10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

G. Cooling Tower:

1. Tower identification/number.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Rated capacity.
6. Entering air WB temperature, specified and actual.
7. Leaving air WB temperature, specified and actual.
8. Ambient air DB temperature.
9. Condenser water entering temperature.
10. Condenser water leaving temperature.
11. Condenser water flow rate.
12. Fan RPM.

H. Cooling Coils:

1. Identification/number.
2. Location.
3. Service.

4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Entering water temperature, design and actual.
13. Leaving water temperature, design and actual.

I. Heating Coils:

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

J. Return Air/Outside Air:

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

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

K. Exhaust Fans:

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

L. 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.

M. Flow Measuring Stations:

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

N. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.

7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

O. Air Distribution Tests:

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

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

- A. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

1.3 REFERENCE STANDARDS:

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

1.4 SUBMITTALS:

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

1.5 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 FIELD CONDITIONS:

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS:

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or ASTM E84.

2.2 GLASS FIBER, FLEXIBLE:

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com.
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

2.3 DUCT LINER:

- A. Manufacturers:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
- B. Note: Choose the liner type - Elastomeric Foam, Glass Fiber, or Phenolic Foam.
- C. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with

poly vinyl acetate polymer or acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.

1. Apparent Thermal Conductivity: Maximum of .24 at 75 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION:

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

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

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Equipment insulation.
- B. Chillers.
- C. Heat exchangers.
- D. Converters.
- E. Chilled-water pumps.
- F. Condenser-water pumps.
- G. Dual-service heating and cooling pumps.
- H. Heating, hot-water pumps.
- I. Heat-recovery pumps.
- J. Steam condensate pumps.
- K. Expansion/compression tanks.
- L. Air separators.
- M. Thermal storage tanks.
- N. Deaerators.
- O. Steam condensate tanks.
- P. Steam flash tanks, flash separators, moisture separators, and blow-off tanks.
- Q. Piping system filtration unit housings.
- R. Outdoor, aboveground, heated, fuel-oil storage tanks.
- S. Jacketing and accessories.

1.2 REFERENCE STANDARDS:

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- H. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

1.3 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials, thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any). and thickness for equipment scheduled.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
 - 2. Sheet Form Insulation Materials: 12 inches (300 mm) square.
 - 3. Sheet Jacket Materials: 12 inches (300 mm) square.
 - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

- D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail removable insulation at equipment connections.
 - 4. Detail application of field-applied jackets.
 - 5. Detail application at linkages of control devices.
 - 6. Detail field application for each equipment type.

1.4 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 _____ years of experience.
- C. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Accept materials on site in original factory packaging, labeled 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.

- C. A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 FIELD CONDITIONS:

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS:

- A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. See "Product Characteristics" Article in Evaluations for comparisons and temperature ranges for insulation material properties.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products shall be Greenguard certified for Children & Schools.
- E. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- G. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2 GLASS FIBER, FLEXIBLE:

- A. Manufacturers:
 - 1. Knauf Insulation; ____: www.knaufinsulation.com.
 - 2. Owens Corning Corporation; ____: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1,000 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.

- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 2. Secure with self-sealing longitudinal laps and butt strips.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.3 GLASS FIBER, RIGID:

- A. Manufacturer:
 - 1. Knauf Insulation; _____: www.knaufusa.com.
 - 2. Owens Corning Corporation; _____: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 - 1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1,200 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 - 4. Maximum Density: 8.0 pcf.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with self-sealing longitudinal laps and butt strips.
 - 4. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

2.4 CELLULAR GLASS:

- A. Manufacturer:
 - 1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com/#sle.
 - 2. Pittsburgh Corning Corporation: Foamglass.

- B. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- C. Block Insulation: ASTM C 552, Type I.
- D. Special-Shaped Insulation: ASTM C 552, Type III.
- E. Board Insulation: ASTM C 552, Type IV.
- F. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

2.5 HYDROUS CALCIUM SILICATE:

- A. Manufacturer:
 - 1. Johns Manville Corporation; _____: www.jm.com/#sle.
 - 2. Industrial Insulation Group (IIG): Thermo-12 Gold.
- B. Insulation: ASTM C533; rigid molded, asbestos free, gold color. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement.
- C. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.
- D. Insulating Cement: ASTM C449.

2.6 FLEXIBLE ELASTOMERIC CELLULAR INSULATION:

- A. Manufacturer:
 - 1. Aeroflex USA, Inc; AEROFLEX EPDM Sheet/Roll: www.aeroflexusa.com/#sle.
 - 2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
 - 3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3, in sheet form. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.

2.7 ADHESIVES:

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Product attributes in first paragraph below are based on Foster Brand products; there are variations among manufacturers.
- C. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Product: Subject to compliance with requirements, provide Armacell LLC; Armaflex 520 Adhesive or comparable product by one of the following:
 - a. Aeroflex USA, Inc
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company.
 - c. K-Flex USA.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Product: Subject to compliance with requirements, provide Armacell, LLC; Armaflex 520BLV Adhesive or comparable product by one of the following:
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.

I. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.

- d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- J. PVC Jacket Adhesive: Compatible with PVC jacket.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 SEALANTS:

- A. Sealants are categorized into "joint sealants" and "flashing sealants." Joint sealants are primarily used for vapor sealing longitudinal seams and butt joints of insulation materials. Flashing sealants are primarily used for sealing jacket and mastic materials.
- B. Joint Sealants:
- 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 4. Permanently flexible, elastomeric sealant.
 5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 6. Color: White or gray.
 7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges- Marathon Industries; 405.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 5. Color: Aluminum.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 5. Color: White.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.9 JACKETING AND ACCESSORIES:

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing
- C. PVC Plastic: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedule.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: Zeston Series www.jm.com.
 - b. P.I.C. Plastics Inc FG Series.
 - c. Proto Corporation: LoSmoke.
- D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet. Alloy 3003, 3005, 3105, or 5005, Temper H-14
 - 1. Thickness: 0.016 inch sheet.
 - 2. Joining: Longitudinal slip joints and 2 inch laps.
 - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
 - 4. Moisture Barrier for Indoor Application: 1 mil (0.025 mm) thick, heat-bonded polyethylene and kraft paper.
 - 5. Moisture Barrier for Outdoor Application: 3 mil (0.075 mm) thick, heat bonded polyethylene and kraft paper
 - 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 SECUREMENTS:

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Wing seals are primarily used for fastening bands together. Closed seals are occasionally used for large, 84-inch- (2130-mm-) diameter applications and where fastening bands are used with springs. Wing seals are reusable; closed seals are not.
3. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
4. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal.
5. Springs are used for large, 84-inch- (2130-mm-) diameter applications and on applications with rapid changes in expansion and contraction.
6. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - i. AGM Industries, Inc.; CWP-1.
 - ii. GEMCO; CD.
 - iii. Midwest Fasteners, Inc.; CD.
 - iv. Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - i. AGM Industries, Inc.; CHP-1.
 - ii. GEMCO; Cupped Head Weld Pin.
 - iii. Midwest Fasteners, Inc.; Cupped Head.
 - iv. Nelson Stud Welding; CHP.
- 3. Pre-Formed Engineered Pipe Hangers: Elastomeric foam with urethane inserts and an outside, painted, aluminum jacket
 - a. Product: Subject to compliance with requirements, provide Armacell LLC; ArmaFix IPH or comparable product by one of the following:
- 4. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - i. AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - ii. GEMCO; Perforated Base.
 - iii. Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 5. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - i. GEMCO; Nylon Hangers.

- ii. Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
6. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - i. AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, Series.
 - ii. GEMCO; Peel & Press.
 - iii. Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: [Copper- or zinc-coated, low-carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

END OF SECTION

SECTION 23 08 02

INSTALLATION & ACCEPTANCE TESTING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 INTRODUCTION:

- A. Title 24 requires the completion of applicable Certificates of Installation and Certificates of Acceptance for mechanical systems. This shall include applicable mechanical systems as defined in the energy compliance sheets included with the contract documents.

1.2 RELATED DOCUMENTS:

- A. Contract drawings and specifications, general provisions of the contract, including general and supplementary conditions, mechanical provisions and Division-1 Specification sections apply to work of this section.

1.3 DESCRIPTION OF WORK:

- A. Complete Title 24 required Certificate(s) of Installation (NRCI) and Certificate(s) of Acceptance (NRCA) to be completed per the contract documents.

1.4 RESPONSIBILITIES OF INSTALLING CONTRACTORS:

A. General Contractor (GC)

- 1. Ensure that contractors identified as the contractor responsible for acceptance testing and completion of the Title 24 Certificate(s) of Acceptance are certified by the State of California or its designated body to conduct each respective test.

B. Mechanical Contractor (MC)

- 1. Verify proper installation and performance of mechanical services provided.
- 2. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup/programming of mechanical control equipment.
 - a. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - b. Make Certificate(s) of Installation available for building inspector's review.
 - c. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
 - d. Correct labeling of circuits with connected equipment.
- 3. Complete the Certificate(s) of Acceptance per the contract documents.

- a. The company installing the mechanical systems must be an authorized Mechanical Controls Acceptance Test Employer certified by a Mechanical Controls Acceptance Test Technician Certification Provider or include in their bid the cost of retaining and overseeing a contractor who is an authorized Mechanical Controls Acceptance Test Employer to complete the acceptance testing.
 - b. At the discretion of the GC, the Mechanical Controls Acceptance Testing may be completed by the Testing & Balancing (TAB) Contractor if the TAB contractor's company and personnel meet requirements in this specification section.
 - c. Required acceptance testing must be completed by a Mechanical Controls Acceptance Test Technician employed by the Mechanical Controls Acceptance Test Employer.
 - d. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - e. Provide copies of Certificate(s) of Acceptance to the GC for review by the building inspector
 - f. Upload Certificate(s) of Acceptance to the California Title 24 Certificates of Acceptance database, if, at the time of project completion, the database is available to the public.
4. Successful completion of the required Acceptance Tests is the responsibility of the installing contractor. Any costs associated with modifications necessary to obtain compliance and re-testing of systems shall be included in the base bid of this project.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. HVAC control programs.

1.2 REFERENCE STANDARDS:

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTALS:

- A. Product Data: Provide data for each system component and software module.
- B. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List connected data points, including connected control unit and input device.
 - 3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 - 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 5. Indicate description and sequence of operation of operating, user, and application software.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Include submittals data in final "Record Documents" form.
- E. Operation and Maintenance Data:

1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.4 QUALITY ASSURANCE:

- A. Perform work in accordance with NFPA 70.

1.5 WARRANTY:

- A. Provide five year manufacturer's warranty for field programmable micro-processor based units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Carrier Controls
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 HVAC CONTROL PROGRAMS:

- A. General:
1. Support Inch-pounds units of measurement.
 2. Identify each HVAC Control system.
- B. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
 2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
 3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.

4. Use outside air temperature to determine early shut down with ventilation override.
5. Operator commands:
 - a. Define term schedule.
 - b. Define heating/cooling parameters.
 - c. Lock/unlock program.
6. Control Summary:
 - a. HVAC Control system begin/end status.
 - b. Heating/cooling mode status.
 - c. Start/Stop times.
7. Mass temperature summary:
 - a. Heating/cooling season limits.
8. HVAC point summary:
 - a. Control system identifier and status.
 - b. Point ID and status.
 - c. Outside air temperature point ID and status.
 - d. Mass temperature point ID and point.
 - e. Period start.

C. Supply Air Reset:

1. Monitor heating and cooling loads in building spaces, terminal VVT systems, and single zone unit discharge temperatures.
2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
 - a. Raising cooling temperatures to highest possible value.
 - b. Reducing heating temperatures to lowest possible level.
3. Operator commands:
 - a. Lock/unlock program.
 - b. Define space load and load parameters.

- c. Request space load summary.
- 4. Control summary:
 - a. HVAC control system status (begin/end).
 - b. Supply air reset system status.
 - c. Heating and cooling loop.
 - d. High/low limits.
- 5. Space load summary:
 - a. HVAC system status.
 - b. Heating/cooling loop status.
 - c. Current space load point value.
 - d. Fan status point ID and status.
 - e. Control discharge temperature point ID and status.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 230993.
- C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.2 MANUFACTURER'S FIELD SERVICES:

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

3.3 DEMONSTRATION AND INSTRUCTIONS:

- A. Demonstrate complete and operating system to Owner.

3.4 SCHEDULES:

A. Input/Output Schedule:

B. Alarm Schedule:

1. High Limit: A1.
2. Low Limit: A2.
3. Run Time: A3.
4. Maintenance: A4.
5. Status: A5.
6. Override: A6.
7. Freeze: A7.

END OF SECTION

SECTION 23 09 93
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUBMITTALS:

- A. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.2 QUALITY ASSURANCE:

- A. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in California.

PART 2 - PRODUCTS & EXECUTION - SEE SHEETS M-B401.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 REFERENCE STANDARDS:

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

1.3 SYSTEM DESCRIPTION:

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

C. Liquid Indicators:

1. Use line size liquid indicators in main liquid line leaving condenser.

2. If receiver is provided, install in liquid line leaving receiver.

D. Valves:

1. Use service valves on suction and discharge of compressors.

2. Use gauge taps at compressor inlet and outlet.

E. Filter-Driers:

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

F. Solenoid Valves:

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

1.4 SUBMITTALS:

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

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

1. See Section 016000 - Product Requirements, for additional provisions.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION:

A. Filter-Driers:

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

2.2 REGULATORY REQUIREMENTS:

2.3 PIPING:

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
- B. Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
- C. Pipe Supports and Anchors:
 1. Conform to ASME B31.5.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

2.4 MOISTURE AND LIQUID INDICATORS:

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

2.5 VALVES:

- A. Service Valves:
 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

2.6 FILTER-DRIERS:

- A. Performance:
 1. Flow Capacity - Liquid Line: _____ ton, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
 2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
 3. Design Working Pressure: per manufactures recommendation, minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.

1. Connections: As specified for applicable pipe type.

2.7 SOLENOID VALVES:

- A. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.
- B. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION:

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 083100.
- H. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- I. Refrigerant piping shall be provided with insulation. All exterior insulation shall be provided with an aluminum jacket and UV protection.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Metal ducts.

1.2 RELATED REQUIREMENTS:

- A. Section 230130.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- B. Section 230713 - Duct Insulation: External insulation and duct liner.
- C. Section 233300 - Air Duct Accessories.
- D. Section 233319 - Duct Silencers.
- E. Section 233700 - Air Outlets and Inlets: Fabric air distribution devices.

1.3 REFERENCE STANDARDS:

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

1.4 PERFORMANCE REQUIREMENTS:

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

1.5 SUBMITTALS:

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

1.6 FIELD CONDITIONS:

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
- F. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
 - 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.2 MATERIALS:

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 2. VOC Content: Not more than 250 g/L, excluding water.
 3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- C. Flexible Ducts:
 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.
 - c. Temperature Range: -20 degrees F to 210 degrees F.
- D. Insulated Flexible Ducts:
 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.

- c. Temperature Range: -20 degrees F to 210 degrees F.
- E. Low Pressure Supply (System with Cooling Coils): 1 inch w.g. pressure class, galvanized steel.
- F. Medium and High Pressure Supply: 6 inch w.g. pressure class, galvanized steel.
- G. Return and Relief: 1 inch w.g. pressure class, galvanized steel.
- H. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- I. Hanger Rod: ASTM A 36/A 36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 DUCTWORK FABRICATION:

- A. Fabricate ductwork gauge in accordance with current (CMC) California Mechanical Code and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Tee's, bends, and elbows: Construct according to (CMC) California Mechanical Code and SMACNA (DCS).
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.4 DUCT MANUFACTURERS:

- A. Metal-Fab, Inc: www.mtlfab.com.
- B. SEMCO Incorporated: www.semcoinc.com.
- C. United McGill Corporation: www.unitedmcgill.com.

2.5 METAL DUCTS

- A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- E. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- F. Locate ducts and dampers with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- J. Connect diffusers or return air boots to low pressure ducts with 5 feet maximum length of flexible duct.
- K. Flexible air ducts shall not be used in lieu of ridged elbows or fittings. Flexible air ducts shall be permitted to be used as an elbow at a terminal device
 1. Elbow at a terminal device shall be provide with straps and support, "FlexRight" (Durable Elbow Support).
 2. Shall be a universal-mount, 1-piece, fully adjustable, radius forming brace

3. Classified: UL 2043
 4. Material: 100 percent recycled copolymer polyporpylene
 5. Support Frame Radius: 8 Inches
 6. Compliance for Flexible Duct Radius with SMACNA HVAC Duct Construction Standards and ASHRAE Advanced Energy Design Guides
 7. Manufacturer: Build Right Products or equal
- L. Install flexible duct elbow supports in accordance with manufacturer's instructions.
- M. Install flexible duct elbow supports over outer jacket of flexible ducts to form smoot, 90-degree bends to eliminate flexible duct kinks and airflow restrictions
- N. Make bends in flexible ducts with minimum of 1-duct diameter centerline radius
- O. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- P. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 REFERENCE STANDARDS:

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

1.3 SUBMITTALS:

- A. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.4 QUALITY ASSURANCE:

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

1.5 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS:

A. Manufacturers:

1. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
2. PCI Industries, Inc; Pottorff Brand; : www.portorff.com.
3. Ruskin Company: www.ruskin.com/#sle.
4. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.

- B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with worm drive mechanism with removable key operator.

2.2 BACKDRAFT DAMPERS:

A. Manufacturers:

1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
2. Nailor Industries, Inc: www.nailor.com/#sle.
3. PCI Industries, Inc; Pottorff Brand : www.portorff.com.
4. Ruskin Company: www.ruskin.com/#sle.

- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.3 DUCT ACCESS DOORS:

A. Manufacturers:

1. Nailor Industries, Inc: www.nailor.com/#sle.
2. Ruskin Company: www.ruskin.com/#sle.
3. SEMCO LLC: www.semcohvac.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

- B. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.4 DUCT TEST HOLES:

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.5 FLEXIBLE DUCT CONNECTORS:

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

2.6 VOLUME CONTROL DAMPERS:

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 - 2. Nailor Industries, Inc: www.nailor.com/#sle.
 - 3. PCI Industries, Inc; Pottorff Brand : www.portorff.com.
 - 4. Ruskin Company: www.ruskin.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- D. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.

- E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Diffusers:
 - 1. Rectangular ceiling diffusers.
- B. Registers/grilles:
 - 1. Ceiling-mounted, exhaust and return register/grilles.

1.2 REFERENCE STANDARDS:

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

1.3 SUBMITTALS:

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit sheets indicating materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and nose ratings.

1.4 QUALITY ASSURANCE:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

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

2.2 RECTANGULAR CEILING DIFFUSERS:

- A. Type: Provide square, adjustable pattern, stamped, multi-core diffuser to discharge air in four way pattern with sectorizing baffles where indicated.
- B. Frame: T-Bar and Surface mount type. In plaster ceilings, provide plaster frame and ceiling frame. In T-Bar ceiling provide filler panel.
- C. Fabrication: Steel with baked enamel off-white finish.

2.3 CEILING EXHAUST AND RETURN REGISTERS/GRILLES:

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with airtight connection.
- D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.

3.2 SCHEDULES SHOWN ON SHEET M-B001.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Disposable, extended area panel filters.

1.2 REFERENCE STANDARDS:

- A. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).

1.3 SUBMITTALS:

- A. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

PART 2 - PRODUCTS

2.1 FILTER MANUFACTURERS:

- A. American Air Filter Company, Inc: www.aafintl.com
- B. Camfil, a company of the The Camfil Group: www.camfil.us
- C. CLARCOR Air Filtration Products: www.airguard.com

2.2 DISPOSABLE, EXTENDED AREA PANEL FILTERS

- A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid by corrugated aluminum separators.
 - 1. Frame: Non-flammable.
 - 2. Nominal size: 24 by 24 inches.
 - 3. Nominal thickness: 2 inches.
- B. Minimum Efficiency Reporting Value (MERV): 13, when tested in accordance with ASHRAE Std 52.2.
- C. Rating, per ASHRAE Std 52.2:

1. Weight arrestance: 97 percent.
2. Initial resistance at 500 FPM face velocity: 0.30 inch WG.
3. Recommended final resistance: 1.0 inch WG.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 REFERENCE STANDARDS:

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- E. ASHRAE Std 90.2 - Energy-Efficient Design of Low-Rise Residential Buildings; 2007, Including All Addenda.
- F. NFPA 54 - National Fuel Gas Code; 2024.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- I. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.
- J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.3 SUBMITTALS:

- A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

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

1.4 WARRANTY:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Carrier Corporation: www.carrier.com
- B. Mitsubishi Electric: meus1.mylinkdrive.com

2.2 SYSTEM DESIGN:

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.
- C. Electrical Characteristics:
 - 1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 260583.

2.3 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS:

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
2. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS:

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

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.

3.2 INSTALLATION:

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.
- E. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE:

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

1.2 GENERAL REQUIREMENTS:

- A. Guarantee See General Conditions:
 - 1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 - 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the

Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.

B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

C. Codes and Regulations:

1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:

- a. Institute of Electrical and Electronic Engineers - IEEE
- b. National Electrical Manufacturers' Association - NEMA
- c. Underwriters' Laboratories, Inc. - UL
- d. National Fire Protection Association - NFPA
- e. American Society for Testing and Materials - ASTM
- f. American National Standards Institute - ANSI
- g. California Electrical Code - CEC, Title 24, Part 3
- h. California Code of Regulations, Title 8, Subchapter 5
- i. California Building Code-CBC, Title 24 Parts 1 &2
- j. State & Municipal Codes in Force in the Specific Project Area
- k. Occupational Safety & Health Administration - OSHA
- l. California State Fire Marshal
- m. California Fire Code- CFC, Title 24 Part 9
- n. National Electrical Testing Association - NETA

2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.

D. Requirements of Regulatory Agencies:

1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

E. Shop Drawings:

1. See Division 01 for additional requirements.
2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.
5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.
 - a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
 - b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
 - c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals

shall not be reviewed unless supporting calculations and data are submitted therewith.

- d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
 - e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
 - f. Reference listings to the specifications' Sections and Article to which each is applicable.
 - g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.
6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.
- F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.
- G. Standard of Quality
- 1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.
 - 2. Items for similar application shall be of the same manufacturer.
 - 3. The label of listing by UL shall appear on all materials and equipment for which standards have been established by the agency.
 - 4. Where codes as listed in Section General Requirement Section of the Specifications that establish label or approved requirements, furnish all materials and equipment with either the required labels affixed or the necessary written approval.
 - 5. Provide the type and quantity of electrical materials and equipment necessary to complete Work and all systems in operation, tested and ready for use.
 - 6. Provide and install all incidental items that belong to the Work described and which are required for complete systems.

7. All switchboards, distribution boards, panel boards and circuit breakers shall be of the same manufacturer.
8. All wiring devices such as switches and receptacles shall be of the same manufacturer.

H. Substitutions: Refer to Division 01

I. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:

1. General Requirements:

- a. Main service and distribution switchboards.
- b. Panelboards.
- c. Conduits
- d. Conductors, include all selected insulation types.
- e. Fuses
- f. Disconnect switches and Starters.
- g. Pullboxes, manholes and handholes.
- h. Standard lighting fixtures, specially fabricated fixtures, ballasts and lamps, with samples and sample of standard finish available (where requested).
- i. Control devices, standard and special receptacles, switches, outlets and finish device plates.
- j. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
- k. Fire alarm system.
- l. Transformers

J. Utility Service:

1. Contractor shall verify the locations shown on the drawings and shall include extensions of lines to building service from locations which are acceptable to the Owner.
2. Verify electrical, civil, architectural and structural, dimensional and other requirements with the Owner.

3. Should any major modifications to the work indicated be necessary to comply with the Owner requirements, notify the Architect.
4. Contractor shall contact the utility company representatives to establish pre-construction coordination, obtain all necessary meters and/or approvals, and schedule utility work to coordinate with the construction schedule.
5. All utility services shall be installed per the utility company requirements. Verify final construction requirements with utility company service planners prior to construction.

K. Record Drawings: Refer to Division 01, Contract Closeout.

L. Work Responsibilities:

1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.
2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.

8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.
- M. Installation General: For special requirements, refer to specific equipment under these requirements.
1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
 2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
 3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
 4. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
 5. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
 6. Protect work, materials and equipment and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.
 7. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
 8. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.
 9. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.

10. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
11. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.

N. Excavation, Cutting and Patching:

1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 2. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

O. Tests

1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Owner's Representative. Demonstrate system and equipment to operate in accordance with

requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.

6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.

P. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.

Q. Cleaning Up:

1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
4. Leave the entire installation in a clean condition.

R. Completion:

1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.

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

- d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.
- V. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- W. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.3 PROJECT RECORD DOCUMENTS:

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2012 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- C. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- D. Final Record Drawings: Conform to Division 01 requirements.
- E. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- F. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- G. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.

- H. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.
- I. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Refer to Division 01.
- J. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- K. Warranty Certificates: Comply with Division 01.

PART 2 – COMMISSIONING:

2.1 COMMISSIONING OF ELECTRICAL SYSTEMS

- A. Include cost for commissioning requirements in the contract price.
- B. Attend commissioning meetings scheduled by the CxA.
- C. Prepare preliminary schedule for indoor lighting system inspections, O&M manual submission, training sessions, lighting controls testing, system verification, performance testing, and system completion for use by the CxA. Update schedule as appropriate throughout the construction period and provide updated schedule to the commissioning team.
- D. Verify proper installation and performance of all electrical services provided.
- E. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup of HVAC and electrical equipment.
 - 1. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Make Certificate(s) of Installation available for CxA review upon request.
 - 3. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.

1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as California Advanced Lighting Controls Training Program Acceptance Technician (CALCTP-AT) employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Participate in the Certificate(s) of Acceptance and Functional Performance Tests as required to achieve design intent.
- I. Participate in the opposite-season testing as required to achieve design intent.
- J. Participate in O&M Training as required by project specifications.
- K. Ensure participation of major equipment manufacturers and their representatives as applicable.
- L. Obtain O&M data on all equipment and assemble in binders using tabs as required.
- M. Conduct a maintenance orientation and inspection with hands on training per the contract documents.
- N. Provide written certification and completed Certificate(s) of Installation forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed.
1. Correct labeling of all circuits with connected equipment.
 2. Lighting system controls operations, including occupancy sensors, automatic time controls or Energy Management control, override timers, manual dimming controls, exterior lighting controls, multi-level switching, as applicable to the Work.

END OF SECTION

PART 1 - EXECUTION

1.1 EXAMINATION:

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Beginning of demolition means installer accepts existing conditions.

1.2 PREPARATION:

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

1.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK:

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. 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.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

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

1.3 REFERENCE STANDARDS:

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS:

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

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

1.6 QUALITY ASSURANCE:

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

1.7 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS:

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS:

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.

I. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 - 4) 20A exterior circuits: 10 AWG..
2. Control Circuits: 14 AWG.

J. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
 - a. 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. Equipment Ground, All Systems: Green.

2.3 SINGLE CONDUCTOR BUILDING WIRE:

A. Manufacturers:

1. Copper Building Wire:

- a. Cerro Wire LLC: www.cerrowire.com/#sle.
- b. Encore Wire Corporation: www.encorewire.com/#sle.
- c. Southwire Company: www.southwire.com/#sle.
- d. Rome Wire and Cable.
- e. Okonite Wire
- f. Pirelli Wire and Cable
- g. Carol Cable

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:

- a. Size 10 AWG and Smaller: Solid.
- b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.

2.4 WIRING CONNECTORS:

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

C. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.5 ACCESSORIES:

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
5. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant:

1. Listed and labeled as complying with UL 267.
2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
3. Suitable for use at installation temperature.

D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION:

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

3.3 INSTALLATION:

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

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

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

G. Install conductors with a minimum of 12 inches of slack at each outlet.

H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

K. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.

3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 3. Wet Locations: Use heat shrink tubing.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Identify conductors and cables in accordance with Section 260553.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section Firestopping.

- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL:

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

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

1.3 REFERENCE STANDARDS:

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS:

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

1.6 QUALITY ASSURANCE:

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

1.7 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS:

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.

4. Concrete-Encased Electrode:

- a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

5. Ground Rod Electrode(s):

- a. Provide two electrodes unless otherwise indicated or required.
- b. Space electrodes not less than 10 feet from each other and any other ground electrode.
- c. Provide ground access well for each electrode.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

- a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
- b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
- c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

G. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:

1. Provide grounding electrode system for each separate building or structure.

2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. 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 NFPA 70.
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 NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

K. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

2.2 GROUNDING AND BONDING COMPONENTS:

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:

1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

F. Ground Access Wells:

1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
- D. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL:

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 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; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

- 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
- 2. Coordinate work to provide additional framing and materials required for installation.
- 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
- 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
- 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 033000.

1.4 SUBMITTALS:

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.5 QUALITY ASSURANCE:

1.6 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS:

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

- b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
 - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 2. Comply with MFMA-4.
 - 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 2. New Concrete: Use preset concrete inserts.
 - 3. Existing Concrete: Use expansion anchors.
 - 4. Solid or Grout-Filled Masonry: Use expansion anchors.
 - 5. Hollow Masonry: Use toggle bolts.
 - 6. Hollow Stud Walls: Use toggle bolts.
 - 7. Steel: Use welded threaded studs complying with AWS D1.1/D1.1M with lock washers and nuts or Beam clamps (MSS Type 19 21 23 25 or 27) complying with MSS SP-69.

8. Sheet Metal: Use sheet metal screws.
9. Wood: Fasten with lag screws or through bolts.
10. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
11. Plastic and lead anchors are not permitted.
12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners in accordance with manufacturer's recommended torque settings.
- K. Remove temporary supports.

3.3 CONCRETE BASES:

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

3.4 FIELD QUALITY CONTROL:

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 REFERENCE STANDARDS:

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- G. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- J. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- K. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

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

1.3 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.4 SUBMITTALS:

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

1.5 QUALITY ASSURANCE:

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

PART 2 - PRODUCTS

2.1 CONDUIT APPLICATIONS:

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
 - 4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
 - 5. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 - 6. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- J. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.
- L. Corrosive Locations Above Ground: Use stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), stainless steel electrical metallic tubing (EMT), or reinforced thermosetting resin conduit (RTRC).
- M. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).
- N. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- O. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.2 CONDUIT - GENERAL REQUIREMENTS:

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

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC):

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

2.4 STAINLESS STEEL RIGID METAL CONDUIT (RMC):

2.5 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC):

2.6 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC):

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

C. PVC-Coated Boxes and Fittings:

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

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.7 FLEXIBLE METAL CONDUIT (FMC):

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:

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

2.8 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC):

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:

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

2.9 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT):

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.10 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT):

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC):

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: As recommended by manufacturer.
- C. Fittings: Same type and manufacturer as conduit to be connected.

2.12 ACCESSORIES:

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

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

- D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.
- E. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.
- F. Conduit Routing:
1. Unless dimensioned, conduit routing indicated is diagrammatic.
 2. When conduit destination is indicated without specific routing, determine exact routing required.
 3. Conceal conduits unless specifically indicated to be exposed.
 4. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 5. Arrange conduit to maintain adequate headroom, clearances, and access.
 6. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 7. Arrange conduit to provide no more than 150 feet between pull points.
 8. Route conduits above water and drain piping where possible.
 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 12. Group parallel conduits in same area on common rack.
- G. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.

H. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.

7. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

J. Underground Installation:

1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape in accordance with Section 260553 along entire conduit length.

K. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section Concrete with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

M. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

O. Provide grounding and bonding; see Section 260526.

P. Identify conduits; see Section 260553.

3.3 FIELD QUALITY CONTROL:

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING:

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

3.5 PROTECTION:

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 REFERENCE STANDARDS:

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS:

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

1.5 QUALITY ASSURANCE:

- A. Comply with requirements of NFPA 70.

PART 2 - PRODUCTS

2.1 BOXES:

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 12. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.

- c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
- 13. Wall Plates: Comply with Section 262726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section Access Panels as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.

H. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Install boxes as required to preserve insulation integrity.

L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 260526.

3.2 CLEANING:

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

3.3 PROTECTION:

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

END OF SECTION

SECTION 26 05 33.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - PRODUCTS

1.1 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

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

1.3 REFERENCE STANDARDS:

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 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.

1.5 SUBMITTALS:

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

1.6 QUALITY ASSURANCE:

- A. Comply with requirements of NFPA 70.

1.7 FIELD CONDITIONS:

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

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS:

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchboards:
 - 1) Identify ampere rating and name.
 - 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. Identify spares and spaces.
 - b. Panelboards:
 - 1) Identify ampere rating and name.

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

B. Identification for Conductors and Cables:

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

C. Identification for Raceways:

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

D. Identification for Boxes:

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

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 262726.

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

F. Identification for Luminaires:

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

2.2 IDENTIFICATION NAMEPLATES AND LABELS:

A. Identification Nameplates:

1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
 - a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
5. Color:
 - a. Normal Power System: White text on black background.

D. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

E. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

F. Format for Control Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS:

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

2.4 VOLTAGE MARKERS:

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

2.5 UNDERGROUND WARNING TAPE:

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:

2.6 WARNING SIGNS AND LABELS:

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

PART 3 - EXECUTION

3.1 PREPARATION:

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

3.2 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: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.

4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.
- 3.3 FIELD QUALITY CONTROL:
- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS:

- A. NEMA MG 1 - Motors and Generators; 2021.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.2 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

1.3 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Study reports, stamped or sealed and signed by study preparer.

1.4 POWER SYSTEM STUDIES:

- A. Scope of Studies:
 - 1. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 - 2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.

B. General Study Requirements:

1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:

1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Study Reports:

1. General Requirements:

- a. Identify date of study and study preparer.
- b. Identify study methodology and software product(s) used.
- c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
- d. Identify base used for per unit values.
- e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
- f. Include conclusions and recommendations.

1.5 QUALITY ASSURANCE:

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Electrical connections to equipment.

1.2 REFERENCE STANDARDS:

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 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.

1.4 QUALITY ASSURANCE:

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, 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.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 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.

END OF SECTION

SECTION 260650.16
LIGHTING FIXTURE SCHEDULE

SECTION 26 08 02

INSTALLATION & ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS

INTRODUCTION

1.1 TITLE 24 REQUIRES THE COMPLETION OF ALL APPLICABLE CERTIFICATES OF INSTALLATION AND CERTIFICATES OF ACCEPTANCE FOR LIGHTING SYSTEMS. THIS SHALL INCLUDE INDOOR AND OUTDOOR LIGHTING SYSTEMS.

1.2 RELATED DOCUMENTS:

- A. Contract drawings and specifications, general provisions of the contract, including general and supplementary conditions, electrical provisions and Division-1 Specification sections apply to work of this section.

1.3 DESCRIPTION OF WORK:

- A. Complete all Title 24 required Certificate(s) of Installation (NRCI) and Certificate(s) of Acceptance (NRCA) to be completed per the contract documents.

1.4 RESPONSIBILITIES OF INSTALLING CONTRACTORS:

A. General Contractor (GC)

- 1. Ensure that all contractors identified as the contractor responsible for acceptance testing and completion of the Title 24 Certificate(s) of Acceptance are certified by the State of California or its designated body to conduct each respective test.

B. Electrical Contractor (EC)

- 1. Verify proper installation and performance of all electrical services provided.
- 2. Meet with acceptance tester at beginning of construction to review project requirements.
- 3. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup/programming of lighting control equipment.
 - a. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - b. Make Certificate(s) of Installation available for building inspector's review.
 - c. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
 - d. Correct labeling of all circuits with connected equipment.

4. Complete the Certificate(s) of Acceptance per the contract documents.
 - a. The company installing the lighting systems must be an authorized Lighting Controls Acceptance Test Employer certified by a Lighting Controls Acceptance Test Technician Certification Provider or include in their bid the cost of retaining and overseeing a contractor who is an authorized Lighting Controls Acceptance Test Employer to complete the acceptance testing.
 - b. All required acceptance testing must be completed by a Lighting Controls Acceptance Test Technician employed by the Lighting Controls Acceptance Test Employer. The acceptance tester shall be present for all commissioning efforts.
 - c. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - d. Upload all Certificate(s) of Acceptance to the California Title 24 Certificates of Acceptance database, if, at the time of project completion, the database is available to the public.
5. Successful completion of the required Acceptance Tests is the responsibility of the installing contractor. Any costs associated with modifications necessary to obtain compliance and re-testing of systems shall be included in the base bid of this project.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Occupancy sensors.

1.2 RELATED REQUIREMENTS:

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches.
- F. Section 265100 - Interior Lighting.

1.3 REFERENCE STANDARDS:

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
 - 2. Coordinate placement of wall switch occupancy sensors with installed door swings.

3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
4. Coordinate placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement.
5. Coordinate lighting control device product selections with luminaire characteristics; see Section 265100 and lighting fixture schedule.
6. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS:

- A. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- B. Shop Drawings:
 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- C. Field quality control reports.
- D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Include detailed information on device programming and setup.
- F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE:

- A. Comply with NFPA 70.
- B. Maintain at project site one copy of each referenced document that prescribes execution requirements.

- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION:

- A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS:

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY:

- A. Provide five year manufacturer warranty for occupancy sensors.
- B. Provide five year manufacturer warranty for all daylighting controls.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS:

- A. Provide products listed, classified, and labeled as suitable for purpose intended.
- B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION:

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION:

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 260533.16.

1. Mounting Heights: Unless otherwise indicated, as follows:

a. Wall Switch Occupancy Sensors: 48 inches above finished floor.

2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.

3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Maintain separation of remote-control, signaling, and power-limited circuits.

1. See manufacturer instructions and Section 260519 for control wiring conductors, wiring methods, and identification requirements.

D. Install lighting control devices in accordance with manufacturer's instructions.

E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Install lighting control devices plumb and level, and held securely in place.

G. Where required and not furnished with lighting control device, provide wall plate; see Section 262726.

H. Provide required supports; see Section 260529.

I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered

without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

J. Identify lighting control devices; see Section 260553.

K. Daylighting Control Photo Sensor Locations:

1. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure light level controlled at designated task location, while minimizing measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
2. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into space, while minimizing measured amount of lighting from artificial sources.

L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near sensor location.

N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.4 FIELD QUALITY CONTROL:

A. Inspect each lighting control device for damage and defects.

B. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

C. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.5 ADJUSTING:

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

B. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as

indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.6 CLEANING:

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

3.7 CLOSEOUT ACTIVITIES:

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY:

- A. Section includes a networked lighting control system comprised of the following components:
 - 1. System Software Interfaces
 - a. Management and Visualization Interface
 - b. Historical Database and Analytics Interface
 - c. Personal Control Applications
 - d. Smartphone Programming Interface for wired devices
 - 2. System Backbone and Integration Equipment
 - a. System Controller
 - b. OpenADR Interface
 - 3. Wired Networked Devices
 - a. Wall Switches, Dimmers and Scene Controllers
 - b. Graphic Wall Stations
 - c. Auxiliary Input/Output Devices
 - d. Occupancy and Photocell Sensors
 - e. Power Packs and Secondary Packs
 - f. Networked Luminaires
 - g. Relay and Dimming Panel
 - 4. Wireless Networked Devices
 - a. Sensor Interface
 - b. Light Controllers
 - c. Digital Sensor Attachments

- d. Networked Luminaires
- e. Communication Bridge
- B. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.
- C. The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

1.2 RELATED DOCUMENTS:

- A. Section 262726 Wiring Devices
- B. Section 260923 Lighting Control Devices
- C. Section 265113 Interior Lighting Fixtures

1.3 SUBMITTALS:

- A. Submittal shall be provided including the following items.
 - 1. Bill of Materials necessary to install the networked lighting control system.
 - 2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
 - 3. Riser Diagrams showing device wiring connections of system backbone and also typical per room/area type.
 - 4. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
 - 5. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
 - 6. Contractor Startup/Commissioning Worksheet (must be completed prior to factory start- up).
 - 7. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
 - 8. Hardware and Software Operation Manuals.

1.4 APPROVALS:

- A. Prior approval from owner's representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.
- B. Any alternate product or system that has not received prior approval from the owner's representative at least 10 days prior to submission of a proposal package shall be rejected.
- C. Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals to owner's representative.
- D. For any alternate system that does not support any form of wireless communication to networked luminaires, networked control devices, networked sensors, or networked input devices, bidders shall provide a total installed cost including itemized labor costs for installing network wiring to luminaires, control devices, sensors, input devices and other required system peripherals.

1.5 QUALITY ASSURANCE:

A. Product Qualifications

- 1. System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
- 2. System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V2.0.
- 3. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
- 4. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
- 5. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. Installation and Startup Qualifications

- 1. System startup shall be performed by qualified personnel approved or certified by the manufacturer.

C. Service and Support Requirements

- 1. Phone Support: Toll free technical support shall be available.
- 2. Remote Support: The bidder shall offer a remote support capability.

3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.6 WARRANTY:

- A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.
- B. The hardware warranty shall cover repair or replacement any defective products within the warranty period.

1.7 MAINTENANCE & SUSTAINABILITY:

- A. The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

PART 2 – EQUIPMENT

2.1 MANUFACTURERS:

- A. Manufacturers that are listed with DesignLights Consortium Networked Lighting Control System Specification V2.0.

2.2 SYSTEM PERFORMANCE REQUIREMENTS:

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) optional system backbone for remote, time based and global operation between control zones.
 - a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
 - b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic

control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher level system backbone; this capability is referred to as “distributed intelligence.”

- c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for each type of network connection, wired or wireless).
- 2. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.
 - 3. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
 - 4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.
 - 5. System shall be capable of “out of box” sequence of operation for each control zone.
 - a. Standard sequence is:
 - 1) All switches control all fixtures in a zone
 - 2) All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics

- 1. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.

2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
 - b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
 - c. Emergency egress devices shall be provided and UL labeled by the lighting control manufacturer.

C. Wireless Networked Control Zone Characteristics

1. Following proper installation and provision of power, all wireless networked devices paired, meshed or grouped together shall automatically follow the “out of box” default sequence of operations.
2. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wallstation signal.
3. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wallstations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.
4. All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
5. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - a. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss or interruption of power sensed via line voltage connections.

D. System Integration Capabilities

1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.

2.3 SYSTEM SOFTWARE INTERFACES:

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
 - a. Switch/occupancy/photosensor group configuration
 - b. Manual/automatic on modes
 - c. Turn-on dim level
 - d. Occupancy sensor time delays

- e. Dual technology occupancy sensors sensitivity
- f. Photosensor calibration adjustment and auto-setpoint
- g. Trim level settings

2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT:

A. System Controller

1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
 - a. Facilitation of global network communication between different areas and control zones.
 - b. Time-based control of downstream wired and wireless network devices.
 - c. Linking into an Ethernet network.
 - d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
 - e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
 - a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
 - b. BACnet/MSTP shall support 9600 to 115200 baud.

- c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

B. OpenADR Interface

- 1. System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
- 2. OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:
 - a. Programmable with the account information of the end-user's electrical utility DRAS account credentials.

2.5 WIRED NETWORKED DEVICES:

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

- 1. Wall switches & dimmers shall support the following device options:
 - a. Number of control zones: 1, 2 or 4
 - b. Control Types Supported: On/Off or On/Off/Dimming
- 2. Scene controllers shall support the following device options:
 - a. Number of scenes: 1, 2 or 4
 - b. Control Types Supported:
 - 1) On/Off or On/Off/Dimming
 - 2) Preset Level Scene Type
 - 3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
 - 4) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones

B. Wired Networked Graphic Wall Stations

- 1. Device shall have a full color touch screen.

2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
3. Graphic wall stations shall support the following device options:
 - a. Number of control zones: Minimum of 16
 - b. Number of scenes: Minimum of 16
 - c. Optional password protection for setup screens.

C. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
 - a. Contact closure input
 - 1) Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
 - b. 0-10V analog input
 - 1) Input shall be programmable to function as a daylight sensor.
 - c. RS-232/RS-485 digital input
 - 1) Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
 - d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current
 - 1)

D. Wired Networked Occupancy and Photosensors

1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.

4. Sensor mounting type shall match project design requirements as shown on plans.
 - a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
5. The system shall support the following types of photocell-based control:
 - a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
 - b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors

1. Wall switches sensors shall support the following device options:
 - a. User Input Control Types Supported: On/Off or On/Off/Dimming
 - b. Occupancy Sensing Technology: PIR only or Dual Tech
 - c. Daylight Sensing Option: Inhibit Photosensor

F. Wired Networked Embedded Sensors

1. Embedded sensors shall support the following device options:
 - a. Occupancy Sensing technology: PIR only or Dual Tech
 - b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Distributed System Power, Switching and Dimming Controls

1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
3. Device shall be plenum rated.

4. Devices shall be UL Listed for load and load type as specified on the plans.

H. Wired Networked Luminaires

1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
2. Networked LED luminaire shall provide low voltage power to other networked control devices.
3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

I. Wired Networked Relay and Dimming Panel

1. Relay and dimming panel(s) shall be capable of providing the required amount of relay capacity, as required per panel schedules shown on drawings, with an equal number of individual 0-10V dimming outputs.
2. Standard relays used shall have the following required properties:
 - a. Configurable in the field to operate with normally closed or normally open behavior.
 - b. Provides visual status of current state and manual override control of each relay.
 - c. Be individually programmable
3. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
4. Panel shall be UL924 listed for control of emergency lighting circuits.
5. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel.

2.6 WIRELESS NETWORKED DEVICES:

A. Wireless Networked Sensor Interface

1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Networked Light Controllers (No Sensor)

1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
2. An external antenna attached to the luminaire shall not be allowed.
 - a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.

C. Wireless Networked Digital Sensors

1. In addition to providing Wireless Networked Light Controllers functionality, also provides:
 - a. Integrated digital occupancy sensing and digital photocell sensor.
 - b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
 - c. Sensor shall have software-adjustable settings
 - d. Photocell shall be suitable for closed and open loop applications.

D. Wireless Network Communication Bridge

1. A communication bridge device shall be provided that interfaces with the System Controller via Owner's LAN connection and interfaces with wireless network.
2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, so as to reduce the amount of communication bridges required in the system.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS:

A. Installation Procedures and Verification

1. The successful bidder shall review all required installation and pre-startup procedures with
 - a. the manufacturer's representative through pre-construction meetings.

2. The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
3. The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
 - a. Wire Map (continuity, pin termination, shorts and open connections, etc.)
 - b. Length
 - c. Insertion Loss

B. Coordination with Owner's IT Network Infrastructure

1. The successful bidder is required to coordinate with the owner's representative to secure all
 - a. required network connections to the owner's IT network infrastructure.
 - b. The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
 - c. The bidder shall provide, to the manufacturer's representative, all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

C. Coordination with Mechanical Division

1. The successful bidder shall provide all integration equipment detailed in Division 260943.
2. The successful bidder to verify integration scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

D. Documentation and Deliverables

1. The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.
2. The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:

- a. As-Built floor plan drawings showing wired network control zones outlined, in addition to device address locations required above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.
- b. As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
 - 1) CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
 - (a) Titleblock
 - (b) Text- Inclusive of room names and numbers, fixture tags and drawings notes Fixture wiring and homeruns
 - (c) Control devices
 - (d) Hatching or poché of light fixtures or architectural elements
 - 2) CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

3.2 SYSTEM STARTUP:

- A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
 - 1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.
- B. System start-up and programming shall include:
 - 1. Verifying operational communication to all system devices.
 - 2. Programming the network devices into functional control zones to meet the required sequence of operation.
 - 3. Programming and verifying all sequence of operations.
 - 4. Customization of owner's software interfaces and applications.
- C. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.3 PROJECT TURNOVER:

A. System Documentation

1. Submit software database file with desired device labels and notes completed.

B. Owner Training

1. Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. General purpose transformers.

1.2 RELATED REQUIREMENTS:

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260533.13 - Conduit for Electrical Systems: Flexible conduit connections.

1.3 REFERENCE STANDARDS:

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- F. NEMA ST 20 - Dry Type Transformers for General Applications; 2021.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS:

- A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
- B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

1.6 QUALITY ASSURANCE:

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

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Eaton Corporation: www.eaton.com.
- B. Schneider Electric: www.se.com/#sle.
- C. Siemens Industry, Inc: www.usa.siemens.com.
- D. Source Limitations: Provide transformers produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS:

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F.
 - b. Less than 10 kVA: Not exceeding 77 degrees F.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.

- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS:

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- C. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- D. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20
- G. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.
 - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- H. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Construction: Steel.

- a. Less than 15 kVA: Totally enclosed, non-ventilated.
- b. 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

2.4 SOURCE QUALITY CONTROL:

- A. Factory test transformers according to NEMA ST 20.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 260533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 1. Provide required support and attachment in accordance with Section 260529, where not furnished by transformer manufacturer.
 2. Use integral transformer flanges to support wall-mounted transformers.
 3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
 4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.2 FIELD QUALITY CONTROL:

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.3 ADJUSTING:

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.4 CLEANING:

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

END OF SECTION

PART 1 - PRODUCTS

1.1 LOW-VOLTAGE SWITCHGEAR:

- A. Provide switchgear assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front standard (non-arc-resistant) type metal-enclosed drawout switchgear complying with IEEE C37.20.1 and ANSI C37.51; listed and labeled as complying with UL 1558; ratings, configurations and features as indicated on the drawings.
- D. Service Conditions:
 - 1. Provide switchgear and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature: Between -22 degrees F and 104 degrees F.
 - 2. Provide switchgear and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Short Circuit Current Rating:
- F. Short-Time Current (30-Cycle Withstand) Rating: Equivalent to specified short circuit current rating.
- G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- H. Bussing: Sized in accordance with UL 1558 temperature rise requirements.
 - 1. Main bus (horizontal cross bus) to be fully rated through full length of switchgear.
 - 2. Provide solidly bonded equipment ground bus through full length of switchgear, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 - 3. Phase and Neutral Bus Material: Copper.

- 4. Ground Bus Material: Copper.
 - I. Conductor Terminations: Suitable for use with the conductors to be installed.
 - 1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 - 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - J. Enclosures:
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Finish: Manufacturer's standard unless otherwise indicated.
 - K. Future Provisions:
 - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
 - L. Instrument Transformers:
 - 1. Comply with IEEE C57.13.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.
- 1.2 LOW-VOLTAGE POWER CIRCUIT BREAKERS:
- A. Description: Quick-make, quick-break, trip-free low-voltage power circuit breakers with two-step stored energy closing mechanism; 100 percent rated; complying with IEEE C37.13, IEEE C37.16, IEEE C37.17, and ANSI C37.50; listed and labeled as complying with UL 1066; ratings, configurations, and features as indicated on the drawings.

- B. Interrupting Capacity: Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
- C. Construction: Drawout.
 - 1. Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
 - 2. Provide safety interlock to prevent racking of circuit breaker while in the ON position.
- D. Trip Units: Solid state, microprocessor-based, true rms sensing.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.2 RELATED REQUIREMENTS:

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

1.3 REFERENCE STANDARDS:

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendment (2017).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

- L. UL 891 - Switchboards; Current Edition, Including All Revisions.
- M. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:

1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
3. Obtain Utility Company approval of switchboard prior to fabrication.
4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 SUBMITTALS:

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 2. Identify mounting conditions required for equipment seismic qualification.
- C. Manufacturer's equipment seismic qualification certification.
- D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Enclosure Keys: Two of each different key.

1.6 QUALITY ASSURANCE:

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS:

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Switchboards - Basis of Design: Eaton.
- B. Switchboards:
 - 1. ABB/GE: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric: www.se.com/#sle.
 - 4. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.2 SWITCHBOARDS:

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Service Entrance Switchboards:
 - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
 - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 - 3. Comply with Utility Company requirements for electrical service.
 - 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
- E. Service Conditions:

1. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- F. Short Circuit Current Rating:
1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Listed series ratings are not acceptable.
- G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- H. Bussing: Sized in accordance with UL 891 temperature rise requirements.
1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 3. Phase and Neutral Bus Material: Copper.
 4. Ground Bus Material: Copper.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - 1) Provide mechanical lugs.
- J. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

- a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
 - b. Outdoor Locations: Type 3R.
- 2. Finish: Manufacturer's standard unless otherwise indicated.
- 3. Outdoor Enclosures:
 - a. Color: Manufacturer's standard.
 - b. Access Doors: Lockable, with all locks keyed alike.
- K. Future Provisions:
 - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
 - 2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
 - 3. Where designated spaces for future device provisions are not indicated, include provisions for minimum of 6 device(s) rated at 25 percent of rating of switchboard main or incoming feed.
 - 4. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections where indicated.
- L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- M. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- N. Instrument Transformers:

1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.3 OVERCURRENT PROTECTIVE DEVICES:

A. Circuit Breakers:

1. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Molded Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 2) Provide electronic trip circuit breakers where indicated.
 - b. Minimum Interrupting Capacity:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - e. Provide the following features and accessories where indicated or where required to complete installation:

- 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2.4 SOURCE QUALITY CONTROL:

- A. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
 1. Dielectric tests.
 2. Mechanical operation tests.
 3. Grounding of instrument transformer cases test.
 4. Electrical operation and control wiring tests, including polarity and sequence tests.
 5. Ground-fault sensing equipment test.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install switchboards plumb and level.
- G. Provide grounding and bonding in accordance with Section 260526.

- H. Install all field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable circuit breaker tripping function settings as directed.
- K. Set field-adjustable ground fault protection pickup and time delay settings as directed.
- L. Provide filler plates to cover unused spaces in switchboards.

3.3 FIELD QUALITY CONTROL:

- A. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.1.
- D. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 200 amperes. Tests listed as optional are not required.
- E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- F. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- G. Test shunt trips to verify proper operation.
- H. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.4 ADJUSTING:

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.5 CLEANING:

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

3.6 PROTECTION:

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS:

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS:

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendment (2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- G. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS:

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- C. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- D. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE:

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

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

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

2.2 PANELBOARDS - GENERAL REQUIREMENTS:

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.

- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.

- b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
- 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Load centers are not acceptable.

2.3 POWER DISTRIBUTION PANELBOARDS:

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type.
 - 2. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 225 amperes.
 - 3. Provide electronic trip circuit breakers for circuit breaker frame sizes 225 amperes and above.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS:

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Copper.
 - 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES:

- A. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.

- 2) 14,000 rms symmetrical amperes at 480 VAC.
- b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
8. Do not use tandem circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION:

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
- K. Install all field-installed branch devices, components, and accessories.
- L. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- M. Provide filler plates to cover unused spaces in panelboards.

3.3 FIELD QUALITY CONTROL:

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- C. Test GFCI circuit breakers to verify proper operation.
- D. Test shunt trips to verify proper operation.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING:

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

3.5 CLEANING:

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

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

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

1.3 REFERENCE STANDARDS:

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interruptioners; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS:

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1. Wall Dimmers: Include derating information for ganged multiple devices.

1.6 QUALITY ASSURANCE:

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

PART 2 - PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS:

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.

2.2 MANUFACTURERS:

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

2.3 WIRING DEVICE FINISHES:

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

2.4 WALL SWITCHES:

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.5 RECEPTACLES:

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

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

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION:

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION:

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- O. Identify wiring devices in accordance with Section 260553.

3.4 FIELD QUALITY CONTROL:

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

3.5 ADJUSTING:

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

3.6 CLEANING:

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

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Fuses.

1.2 REFERENCE STANDARDS:

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

1.3 ADMINISTRATIVE REQUIREMENTS:

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

1.4 SUBMITTALS:

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

1.5 QUALITY ASSURANCE:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.
- B. Littelfuse, Inc: www.littelfuse.com.
- C. Mersen: ep-us.mersen.com.

2.2 APPLICATIONS:

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

2.3 FUSES:

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

PART 3 - EXECUTION

3.1 EXAMINATION:

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

3.2 INSTALLATION:

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

END OF SECTION

PART 1 - PRODUCTS

1.1 ENCLOSED CIRCUIT BREAKERS:

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- H. Provide externally operable handle with means for locking in the OFF position.

1.2 MOLDED CASE CIRCUIT BREAKERS:

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:

1. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS:

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

1.3 REFERENCE STANDARDS:

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS:

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

1.6 QUALITY ASSURANCE:

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

1.7 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.

- D. Siemens Industry, Inc: www.usa.siemens.com.
- E. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.2 ENCLOSED SAFETY SWITCHES:

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 - EXECUTION

3.1 EXAMINATION:

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

3.2 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed switches plumb.

- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL:

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING:

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

3.5 CLEANING:

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

END OF SECTION

PART 1 - PRODUCTS

1.1 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS:

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
- E. UL 1449 Voltage Protection Ratings (VPRs):
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.

1.2 RELATED REQUIREMENTS:

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS:

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- B. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- D. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS:

A. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution upon request.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.

2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
3. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
4. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

C. Samples:

1. Provide one sample(s) of each luminaire proposed for substitution upon request.

D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.

E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

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

1. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
3. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.

G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE:

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

1.7 DELIVERY, STORAGE, AND PROTECTION:

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS:

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY:

- A. Provide five year manufacturer warranty for all LED luminaires, including drivers.
- B. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

PART 2 - PRODUCTS

2.1 LUMINAIRE TYPES:

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES:

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EMERGENCY LIGHTING UNITS:

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.4 EXIT SIGNS:

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 2. Directional Arrows: As indicated or as required for installed location.

2.5 BALLASTS AND DRIVERS:

- A. Ballasts/Drivers - General Requirements:
 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. Dimmable LED Drivers:
 1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker.

2. Control Compatibility: Fully compatible with the dimming controls to be installed.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION:

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION:

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Suspended Ceiling Mounted Luminaires:
 1. Do not use ceiling tiles to bear weight of luminaires.
 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 4. Secure pendant-mounted luminaires to building structure.

5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

G. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Suspended Luminaires:

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
4. Install canopies tight to mounting surface.

I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

J. Install accessories furnished with each luminaire.

K. Bond products and metal accessories to branch circuit equipment grounding conductor.

L. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

M. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

N. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL:

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.5 ADJUSTING:

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.6 CLEANING:

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES:

- A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION:

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 51 20
AUTOMATIC LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Provide and design an automatic lighting control system as described in this specification and as called for on the drawings.

1.2 QUALITY ASSURANCE:

- A. Manufacturer shall have a minimum of 10 years experience in manufacturing and installing this type of system.
- B. The Contractor shall provide a list of recent jobs completed during the last 5 years with the name and phone number of a contact person.
- C. All components and assemblies are to be pre-tested and assembled at the factory prior to installation.
- D. Provide a factory-trained technician on site. The technician shall functionally test each component in the system after installation to verify proper operation and confirm that the panel wiring and addressing conform to the wiring documentation.

1.3 SUBMITTALS:

- A. The following list includes the required shop drawings and product data information that shall be submitted.
 - 1. Underwriters Laboratories, Inc. (UL) listing and factory test reports.
 - 2. Internal and system wiring diagrams.
 - 3. Single line diagram of the system configuration. Typical riser diagrams are not acceptable.
 - 4. Dimensions of the equipment layout.
 - 5. Control wiring and conduits layout and connections.
 - 6. Floor plans to scale showing the location of each device and equipment.
 - 7. Product data of all the components including but not limited to programmable central controllers, transceivers panels, input relays, switches and other ancillary equipment.

1.4 REFERENCES:

- A. UL 916 Energy Management Equipment.
- B. FCC Emissions Standards specified in Part 15, subpart J for Class A, Applications.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Provide and microprocessor controlled relay panels for the Lighting Control System. The system shall include programmable standalone master panel, switch inputs, wiring, power supplies, relays and ancillary relays.
- B. Panels shall be capable of standing alone or operating as part of a network.
 - 1. The system shall provide intelligence to operate as follows:
 - a. Store all user operating data.
 - b. Initiate all relay output commands based on:
 - 1) Operator inputs
 - 2) Automatic operating schedule
 - 3) Binary type field sensors
 - 4) Universal override switch inputs
 - 5) Internal 56K Baud modem
 - c. Provide automatic system diagnostics and alarming based on detected faults in the controller, transceiver panels, relays, and data line.
 - 2. System shall include a memory back up to be able to survive an indefinite length of power failure.
- C. Lighting Control Panel (LCP): Microprocessor based, complete prewired assemblies consisting of the following:
 - 1. Stand alone panel controller capable of receiving and acting upon programs downloaded from the central computer. Programs downloaded from the network shall be capable of continuing to operate even if the network should fail. Battery Back up provides 8 days of memory retention. Panel shall be part of a system that can control up to 750 relays and receive up to 500 switch inputs. Panel shall have an USB input for local programming and trouble shooting from a laptop computer.
 - 2. Internal digital clock with self control power.

3. Output modules: Plug in type to receive coded digital commands from the panel controller and pulse output relays to the appropriate state. Actual status feedback of the relays are to be fed back to the panel controller and from there to the central computer. Actual status of each relay is to be indicated by a pilot LED on the control board. Each Module controls 8 or 16 relays.
4. Switch input modules: Plug-in type, actuated by remote external contact closures. These contact closures may be either momentary or maintained. The action of the contact is noted by the panel controller and acted upon as programmed by software. The action of the contact can command any group of output relays to the desired state. Either 8 or 24-input channels as shown on the plans.
5. Output Relays
 - a. Type: Momentary pulsed, mechanically latched with pilot light contact.
 - b. Rating: 20 Ampere, 277VAC
 - c. Number per panel: 16,32 or 48 as required to satisfy this project scope.
6. The low voltage and high voltage sections of the lighting control cabinet shall be separated by a 14 gage steel barrier in which the relays are mounted. In areas where both 120 volt and 277 volt loads are present the high voltage compartment shall have a 14 gage steel barrier between the relays that carry 120 VAC and the relays that carry 277VAC. Each section shall be clearly labeled as to the voltage in that compartment.
7. Panel power supply shall be dual primary 115/277 volts AC, 60 Hz. $\pm 10\%$. Low voltage side shall be protected from power line surges and spikes on the input power. The low voltage section shall be protected against short circuit faults and relay failures.
8. Panels shall be UL approved and shall have a short circuit withstand current rating at 14,000 AIC.
9. Manufacturer: Lighting Control and Design, or G.E. or equal.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. The Lighting Control System shall be installed and wired completely as required by the equipment manufacturer by the contractor, who shall make all necessary wiring connections to the lighting fixtures, override switches, photo cells and equipment.

B. The Contractor shall provide on-site programming time with factory-trained personnel for the system set-up. The Contractor shall set up the software program and program the entire system in accordance with the Owner's instructions.

C. Documentation

1. Accurate "as-built" drawings shall be provided by the Contractor. These shall indicate the load controlled by each relay and the identification number for that switch connected to an input and the identification number of that input. Three sets of space plans or reflected ceiling plans shall be provided by the contractor indicating which fixtures are controlled by each relay.

2. A separate data grade private line with RJ45 jack shall be furnished for each modem.

3.2 SERVICE AND SUPPORT:

A. Startup: After the system has been installed, the Contractor shall provide the services of a factory trained representative of the manufacturer to verify correct operation of all system components. The contractor shall guarantee all material and workmanship involving the system for three years after startup.

B. Training: After system startup and after all the programming is completed, the Contractor shall arrange for a factory trained representative to train the Owner's personnel. The trainer shall instruct the Owner's personnel in how to program the system and demonstrate a typical operating program for an area. The Contractor shall allow for 24 hours' instruction time for the Owner's training.

C. Factory Support: Factory support shall be available free of charge during the three-year warranty period to answer programming and application questions. The manufacturer, or his representative, shall have a remote terminal capable of programming the system to support the Owner's personnel during this period. The Contractor shall include a modem, necessary cabling and telephone extension to support this telecommunications operation. The Contractor shall provide a three-year maintenance service contract as part of the cost.

D. The Contractor shall also provide a software site licensing so that the Owner will be able to transfer the software program from the main computer to the other computers. This transfer shall not be an extra cost to the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS:

- A. Section 078400 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.2 REFERENCE STANDARDS:

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.

UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.
- D. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.
- E. UL 2572 - Mass Notification Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS:

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
 - 1. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification type information.

2. Include plan views, drawn to identified scale, noting locations of fire alarm components and associated building or system coordination, as required by NFPA 72.
3. Include elevations and details of proposed equipment arrangements.
4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and end-of-line and power supervisory devices.
6. Include requirements and control unit diagrams for interfacing with other systems.
7. Indicate system zone boundaries.
8. Include narrative description sequence of operation with input/output matrix.
9. Control Panel: Provide sheet that details exterior and interior views of control panel and clearly shows associated wiring information.

C. Circuit Calculations:

1. Provide NAC ampacity and voltage drop calculations.
2. Provide standby battery calculations.

D. Inspection and Test Reports:

1. Installer to submit inspection and test plan prior to closeout demonstration.

E. Project Record Documents:

1. Submit complete project record drawings within 14 calendar days after acceptance test.
2. Provide record drawings similar to shop drawings, but revised to reflect changes made during construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Fire Alarm Control Unit and Accessory Equipment - Basis of Design: Gamewell-FCI E3 Series by Honeywell; <https://buildings.honeywell.com/us/en/brands/our-brands/gamewell-fci/#sle>.

- B. Source Limitations: Where possible, furnish system components and accessories produced by one manufacturer and obtained from one supplier.

2.2 FIRE ALARM SYSTEM:

- A. Provide new fire alarm system consisting of required components (e.g., equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, and system programming) as necessary for complete operating system that provides functional intent indicated.
- B. Programming and Configuration:
 - 1. Capable of processing Boolean logic including AND, OR, XOR, NOT, TIMING, COUNT, SCHEDULE functions to provide complete programming flexibility.
 - 2. Capability of being programmed off-line using Windows-based software utilized by fire alarm system manufacturer. Capability of being downloaded by connecting laptop computer into any other node in system.
 - 3. Provide four levels of password protection with up to 16 passwords.
 - 4. Capability to accept firmware upgrades via connection with laptop computer, without requirement of replacing microchips.
 - 5. Customizable: Ability to software modify bit-logic for writable system instructions by use of Boolean logic for altered system functions.
- C. Products: Listed, classified, and labeled as suitable for purpose intended.
- D. Power Sources:
 - 1. Primary: Dedicated branch circuits from facility power distribution system.
 - 2. Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.
- E. Fire Alarm System Interfaces:
 - 1. UL 864 listed unless otherwise indicated.
 - 2. Descriptions below are intended to provide means for interface. See project sequence of operations, narrative, and input/output matrix for execution requirements.
 - 3. Provide addressable monitor modules as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring points for each device to be individually identifiable by addressable FACU.

4. Provide addressable relay module as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.

2.3 FIRE ALARM CONTROL UNIT AND RELATED EQUIPMENT:

- A. Provide FACU listed and labeled as complying with agency listings and approval requirements as follows:
 1. UL 864 (Control Units and Accessories for Fire Alarm Systems).
 - a. UUKL (smoke control).
 2. UL 2572 (Mass Notification Systems).
 3. FM (AG) (FM approved).
 4. City of Chicago: Class 1 high rise and Class 2 high rise.
 5. City of Denver Approved.
 6. MEA Fire Department of New York (FDNY).
 7. California State Fire Marshall (CSFM).
- B. Provide fire alarm related equipment that is listed and labeled as complying with UL 864.
- C. Provide cabinets and enclosures as indicated or as required to house system components.
- D. Provide fire alarm system motherboard with the following features:
 1. Microprocessor monitoring system events and performing system programs for control-by-event (CBE) functions.
 2. RS-232C Serial Output: Supervised RS-232C serial port provided to operate remote printers and video terminals, accept downloaded program from portable computer, or provide 80-column readout of all alarms, troubles, location descriptions, time, and date. Standard ASCII communication and code operating from 1,200 to 115,200 baud rate.
 3. Redundant History Log: Capacity for 8,100 event history log supporting local and network functions. If main processor or network node is lost, entire log is accessible at any other Loop Interface board. Capable of test by removing power from INCC command center followed by extraction of history log from any loop driver location, including INCC command center or transponder.
 4. Auto Programming: System provides preprogramming into system for SLC devices on SLC loops. Upon activation of auto programming, only devices that are present

activate. This allows for system commissioning in phases without need of additional downloads.

5. Include two integrated SLC loops. Each SLC loop with capacity for 159 addressable detectors and 159 addressable modules.
 - a. Capability for each node containing SLC loops to store its entire program at one time while allowing installer to activate only devices that are installed during construction.
 - b. Smoke detector alarm verification as standard option that also allows other devices such as manual stations and sprinkler flow to create immediate alarm. Feature is selectable for smoke sensors that are installed in environments prone to nuisance or unwanted alarms.
 - c. Alarm Signals: Alarm signals automatically latched or “locked in” at control panel until operated device is returned to normal and control panel is manually reset. When used for sprinkler flow, “SIGNAL SILENCE” switch may be bypassed, if required by AHJ.
 - d. Drift Compensation – Analog Smoke Sensors: System software automatically adjusts each analog smoke sensor approximately once each week for changes in sensitivity due to effects of component aging or environment, including dust. Each sensor maintains its actual sensitivity under adverse conditions to respond to alarm conditions while ignoring factors which generally contribute to nuisance alarms. System trouble circuitry activates, display “DIRTY DETECTOR” and “VERY DIRTY DETECTOR” indications and identify individual unit that requires maintenance.
 - e. Environmental Drift Compensation: System provides for setting environmental drift compensation by device. When detector accumulates dust in chamber and reaches unacceptable level but yet still below allowed limit, control panel indicates maintenance alert warning. When detector accumulates dust in chamber above allowed limit, control panel indicates maintenance urgent warning.
 - f. Analog Smoke Sensor Test: System software automatically tests each analog smoke sensor minimum of three times daily. Recognize functional test of each photocell (analog photoelectric sensors) and ionization chamber (analog ionization sensors) as required annually by NFPA 72. Failure of sensor activates system trouble circuitry, displays “Test Failed” indication, and identifies failed device.
 - g. NON-FIRE Alarm Module Reporting: Non-reporting type ID available for use for energy management or other non-fire situations. NON-FIRE point operation

does not affect control panel operation nor display message at panel LDC.
Activation of NON-FIRE point activates control by event logic, but does not cause indication on control panel.

- h. Unique 40-character identifier available for each device. Capability to poll 10 devices at once with maximum polling time of two seconds when both SLCs are fully loaded.
 - i. Combination and Multi-Criteria Detectors: Utilize one address per detector while programming independently based on criteria without additional addressing, mapping, or hardware.
6. Additional Fire Alarm System Motherboard-Only Features:
- a. RS-485 Serial Bus: Via ribbon harness or four-wire quick connector for communications with up to 16 panel interface modules up to 3,000 feet from enclosure. See "RS-485 Panel Bus Modules" below.
 - b. Two independent notification appliance circuits, Class A or Class B, rated at 2 A per circuits with integrated synchronization for System Sensor, Wheelock, or Gentex notification appliances.
 - c. 24 V auxiliary power, resettable and non-resettable.
7. Basis of Design Products:
- a. Gamewell-FCI Model ILI-MB-E3, fire alarm system motherboard.

E. User Interface Displays:

- 1. Displays events in assigned region or all events in system.
- 2. Provide power from FACU or UL 864 listed 24 VDC remote power supply with standby capacity equal to or greater than FACU.
- 3. Outdoor Locations: Provide weatherproof heated enclosure with external thumb lock; requires separate 12 VAC power source for heater.
- 4. Basis of Design Products:

F. RS-485 Panel Bus Modules:

- 1. Provide addressable manual switch modules as required with the following features:
 - a. Include 16 individually programmable pushbutton switches capable of controlling speaker, firefighter's telephone, or other addressable control points.
 - b. Three status LEDs (red, yellow, and green) per programmable pushbutton switch

- c. Insertable labels to identify function of each switch and LED combination.
- 2. Basis of Design Products:
 - a. Gamewell-FCI Part 100-0455 (ASM-16), auxiliary switch module.

G. Power Supply Module:

- 1. Incorporate switching technology without use of step-down transformers.
- 2. Supply 9 A continuous-rated output to supply all required power under normal and emergency conditions.
- 3. Integrated battery charger with capacity to charge up to 55 AH batteries while under full load.
- 4. Basis of Design Products:
 - a. Gamewell-FCI Model PM-9, 9 A power supply with integrated battery charger.

H. Alarm Transmission and Integration:

- 1. Basis of Design Products:

2.4 FIRE ALARM SYSTEM INITIATING DEVICES:

A. General Requirements:

- 1. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs. Provide address-setting means on device using rotary switches with simple numerical indicators. Devices which require proprietary tools or dip switches to address device will not be accepted.
- 2. Conventional (Nonaddressable) Devices: Provide addressable monitor modules or two-wire detector zone modules (See "Addressable Interface Modules" article for Basis of Design Products) as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring point for each device in order to be individually identifiable by addressable FACU.
- 3. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable monitor modules only in clean, dry, indoor, nonhazardous locations.
- 4. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.

5. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes and enclosures in accordance with product listing.
6. Devices for Hazardous (Classified) Locations: Listed and labeled as suitable for classification of installed location.

B. Manual Fire Alarm Boxes (Pull Stations):

1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
3. Operation: Dual-action unless otherwise indicated; first requires pushing in then pulling down of lever.
4. Color: Red, in accordance with NFPA 72.
5. Station Reset: Requires use of key or tool.
6. Basis of Design Products:
 - a. Manual Pull Stations:
 - 1) Gamewell-FCI Model MS-7AF addressable manual pull station, indoor rated, dual-action, key lock.

2.5 FIRE ALARM SYSTEM INTERFACE MODULES:

- A. Fire alarm system accessory equipment listed and labeled as complying with UL 864.
- B. Provide addressable interface modules as indicated or required for fire alarm and nonfire alarm interfaced systems.
- C. Individually identifiable by addressable FACU; suitable for connection to FACU SLCs. Provide address-setting means on device using rotary switches with simple numerical indicators. Devices which require proprietary tools or dip switches to address device will not be accepted.
- D. Provide addressable modules suitable for connection to FACU SLCs.
- E. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.

- F. Addressable Monitor Modules: Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable FACU.
- G. Addressable Relay Modules: Provide as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.
- H. Basis of Design Products:
 - 1. Addressable Monitor Modules:
 - a. Gamewell-FCI Model AMM-4F addressable monitor module; single monitoring point, supervises one Class A or Class B circuit of conventional dry-contact input devices; uses single module address on SLC; mounts to nominal 4-inch square or 2-gang box, includes white finish cover.

2.6 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES:

A. Notification Appliances - General Requirements:

- 1. Provide signaling devices listed for fire-protective service and intended operating mode (public or private); suitable for connection to FACU notification NAC.
- 2. Provide addressable control modules as indicated or as required for selective control of notification appliances.
- 3. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (i.e., ceiling or wall mounted).
- 4. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
- 5. Notification Appliances for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes and enclosures in accordance with product listing.
- 6. Notification Appliance Derating: Account for device derating adjustments in accordance with listing where applicable, including but not limited to the following.
 - a. Where accessory protective guards, and enclosures are utilized.
 - b. Where required by field conditions (e.g., ambient temperature).
- 7. Notification Appliances Colors:
 - a. See mounting configuration indicated by floor plan drawing symbols.

- b. Wall-Mounted: Red.
 - c. Ceiling-Mounted: White.
- B. Visible Notification Appliances:
 - 1. Public Mode Operation: Listed and labeled as complying with UL 1971.
 - 2. Strobes: Clear or nominal white lens with flash rate of 1 Hz unless otherwise indicated or required; xenon light source with maximum pulse duration of 0.2 seconds; candela rating as indicated.
- C. Basis of Design Products:
 - 1. Strobes:

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install products in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicate on drawings.
- B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
- C. Provide grounding and bonding in accordance with manufacturer's recommendations; see Section 260526.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.
- E. Identify system wiring, components, and overcurrent protective devices for branch circuits serving fire alarm system; see Section 260553.
- F. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas; maintain all code required access.
- G. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.
- H. Mount fire detection and alarm system devices, control panels, and remote annunciators flush or surface as indicated.
- I. Ensure installation locations of devices and notification appliances are in accordance with local codes, standards, and Ensure manual stations are suitable for surface mounting or

semi-flush mounting as indicated on drawings. Install not less than 42-inches, nor more than 48-inches, above finished floor measured to operating handle.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section compliments and shall be coordinated with the Civil Drawings/requirements and the Geotechnical Report. The most stringent requirements shall be utilized.
- B. Removal and storage of topsoil.
- C. Rough grading and consolidation/compaction the site for site structures, building pads, and related site work.
 - 1. Preparation for excavation, trenching, backfilling, and compacting work.
- D. Excavation of subsoil, stockpiling for later reuse, and removal of excess from the site.
- E. Preparing of subgrade for walks, pavements and site retaining walls.
- F. Excavating, backfilling and compaction for wet utility lines.
- G. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 45 33 - Code Required Special Inspections and Procedures.
- C. Section 01 77 00 - Execution and Closeout Requirements.
- D. Section 31 10 00 - Site Clearing.
- E. Section 31 23 16 - Excavation.
- F. Section 31 23 16.13 - Trenching: Trenching and backfilling for utilities.
- G. Section 31 23 23 - Fill: Filling and compaction.
- H. Section 32 12 16 - Asphalt Paving.
- I. Section 32 13 13 - Concrete Paving.
- J. Section 32 93 00 - Plants: Topsoil in beds and pits.
- K. Project Geotechnical Report (if any).

1.03 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.
 - 1. Accurately record location of all changes in finish elevations and gradients which materially affect drainage.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: For conditions not covered in this section, refer to applicable provisions of the California Building Code (CBC), Chapter 18A - Soils and Foundations, as amended and adopted by authorities having jurisdiction.

- B. Perform Work in accordance with local Public Works Department standards.
 - 1. Maintain one copy on site.

1.05 PROTECTION

- A. Dust Control: Comply with requirements specified in Section 01 50 00 - Temporary Facilities and Controls.
- B. Protection:
 - 1. Comply with general requirements specified in Section 01 50 00 - Temporary Facilities and Controls.
 - 2. Provide protection for walks, curbs, drains, and trees and boxing around corners of existing buildings to prevent damage.
 - 3. Keep adjacent roads, streets and drives clear of dirt and debris from earthwork operations.
- C. Underground Utilities:
 - 1. Buried utility lines may exist.
 - 2. If such are encountered, notify Construction Manager, Architect and Owner and for directions to be followed for preservation, relocation, or demolition of utilities.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil: See Section 31 23 23.
- B. Subsoil: Excavated material, graded free of lumps larger than 3-inches, rocks larger than 6-inches, and debris; or in accordance with trench backfill requirements.
- C. Other Fill Materials: See Section 31 23 23.
- D. Shoring and Bracing: Provide all materials and services necessary to properly engineer and construct shoring for excavations. Selection of materials and design of shoring, underpinning, and bracing of new and existing structures shall be solely the responsibility of the Contractor.
 - 1. Shoring design shall comply with State of California Trenching and Shoring Manual issued by Offices of Structure Construction; 2011.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that survey benchmark and intended elevations for the work are as indicated.
- B. The drawings do not purport to show all below-grade conditions and objects on the site. Refer to Geotechnical Report.
- C. Upon discovery of unknown utility or concealed conditions, discontinue affected work and notify Construction Manager, Architect and Owner for direction. Unforeseen conditions shall be resolved in accordance with the General Conditions.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum. See requirements specified in Section 01 40 00 – Quality Requirements.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
 - 1. Maintain and protect remaining existing utilities which pass through the project area.
- D. Notify utility company to remove and relocate utilities, as required.
- E. Protect site features to remain, including but not limited to benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- G. Protect plants, lawns, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Section 31 23 23 for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 5:1 (H:V) to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- I. Overexcavation for all proposed improvements shall be respective to the geotechnical recommendations. If no geotechnical report exists, overexcavation requirements shall be directed by the soils testing geotechnical engineer during construction.

3.04 SOIL REMOVAL AND STOCKPILING

- A. Topsoil Excavation:
 - 1. Stockpile topsoil to be re-used on site; remove remainder from site.
 - 2. Do not excavate wet topsoil.
- B. Subsoil Excavation:
 - 1. Excavate subsoil from areas to be filled with topsoil, to construct foundations, footings, slabs on grade, paving and to achieve final finish grades.
 - 2. Stockpile subsoil to be re-used on site; remove remainder from site.
 - 3. Do not excavate wet subsoil.

4. Over-excavate to working elevations for backfilling and compaction operations.
 5. Over-excavate to provide suitable space and access for work. Do not excavate into normal 45-degree influence line of bearing of footings without written direction from the Architect. Generally, footings require additional depth and other provisions to avoid interference.
 6. Underpin adjacent structures, paving and other existing features which may be damaged by excavation work, including utilities and pipe chases.
 7. Remove all lumped subsoil, boulders, and rock in excess of 6-inch (150 mm) in greatest dimension.
 8. Stockpile subsoil on site for backfill if soil is appropriate. Stockpile subsoil to depth not exceeding 8-feet. Remove from the site excess subsoil not to be reused.
 9. When excavation through roots is necessary, perform work by hand and cut roots with a sharp axe.
 10. Grade top perimeter of excavations to prevent surface water from draining into excavation. Provide dewatering of excavations as required to ensure suitable conditions for concrete and backfilling operations.
 11. Hand trim excavations to accurate configurations and depths. Remove loose matter.
 12. Machine slope banks of excavations to minimum 1 to 1 ratio horizontal to vertical or angle of repose, if less, until shored. Slope must comply with local codes, ordinances and requirements of agencies having jurisdiction. See Geotechnical Report (if any) for further requirements.
 13. Where excavations are made to a depth greater than that indicated, such additional depth shall be filled with concrete having the same compressive strength as specified for the footing. Correct unauthorized and erroneous excavation at no change in Contract Time or Contract Sum.
 14. Protect excavations from cave-in and from loose soil and other matter from falling in. Comply with all applicable industrial safety regulations.
 15. All permanent cut or fill slopes shall have a maximum slope of 2:1 (H:V) ratio, horizontal to vertical and shall comply with applicable requirements of the California Building Code (CBC).
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet (2.5 m); cover to protect from erosion.

3.05 GRADING

- A. Uniformly grade areas as shown on Drawings to tolerances specified below. Evenly grade between points where elevations are shown or between points of Work and existing grades.
- B. Slope grade away from building perimeters and in unpaved areas at gradient indicated.
- C. Make grade changes gradual. Blend slopes into level areas.

3.06 FINISH GRADING

- A. Before Finish Grading:

1. Verify building and trench backfilling have been inspected.
 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2-inch (13 mm) in size. Remove soil contaminated with petroleum products.
 - C. Where topsoil is to be placed, scarify surface to depth of 3-inches (75 mm).
 - D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches (150 mm).
 - E. Place topsoil in areas indicated.
 - F. Place topsoil where required to level finish grade.
 - G. Place topsoil to thickness as scheduled.
 - H. Place topsoil during dry weather.
 - I. Remove roots, weeds, rocks, and foreign material while spreading.
 - J. Near plants spread topsoil manually to prevent damage.
 - K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
 - L. Lightly compact placed topsoil.

3.07 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16-inches) (30 mm) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2-inch) (13 mm).
- C. Top Surface Under Paving: Plus or minus 1/2-inch (0.05-foot) from required elevation.
- D. Top Surface Under Footings and Foundations: Plus 0, minus 0.2 foot.
- E. Top Surface Under Slabs on Grade: Plus 0, minus 1/2-inch (0.05-foot).

3.08 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches, and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.09 FIELD QUALITY CONTROL

- A. See Section 31 23 23 for compaction density testing.
- B. Field Quality Control: Field inspections and testing shall be performed in accordance with requirements specified in Section 01 40 00 - Quality Requirements. Make required quality control submittals in accordance with requirements specified.
- C. Non-compliance: Should grade elevations, tests of fill or backfill indicate non-compliance with required elevations or density, Contractor shall over-excavate, recompact and retest until specified grade or density is obtained.

1. Costs and Time associated with remedial Work and retesting shall be in accordance with provisions of the General Conditions.
2. Retesting to demonstrate compliance shall be by a testing laboratory acceptable to Owner and shall be at Contractor's expense.

3.10 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

3.11 PROTECTION

- A. Protect completed grading from erosion from weather and traffic.
- B. Over-excavate and recompact areas damaged by construction activities and weather.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.
- C. This section compliments and shall be coordinated with the Geotechnical Report. The most stringent requirements shall be utilized.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Control: Inspection of bearing surfaces.
- B. Section 01 50 00 - Temporary Construction Facilities and Controls: Dewatering excavations and water control.
- C. Section 01 57 13 - 31 32 11 - Soil Surface Erosion Control.
- D. Section 01 77 00 - Execution and Closeout Requirements: General requirements for dewatering of excavations and water control.
- E. Section 02 41 19 – Selective demolition: Shoring and underpinning.
- F. Section 31 22 00 - Grading: Soil removal from surface of site.
- G. Section 31 22 00 - Grading: Grading.
- H. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- I. Section 31 23 16.26 - Rock Removal: Removal of rock during excavating.
- J. Section 31 23 23 - Fill: Fill materials, filling, and compacting.
- K. Section 33 46 00 – Sub-drainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 PROJECT CONDITIONS

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

1.04 COORDINATION OF SPECIFICATION REQUIREMENTS

- A. Coordinate these Specification Section requirements with the project drawings. Comply with more stringent requirements and with those requirements of authorities having jurisdiction.
- B. Comply in full with the recommendations given in the Geotechnical Report.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

3.03 EXCAVATING

- A. Underpin adjacent structures that could be damaged by excavating work.
- B. Excavate to accommodate new structures, construction operations, and paving/site structures per the recommendations in the geotechnical report.
 - 1. Overexcavation beyond new structures and paving/site structures is to be per the recommendations in the geotechnical report.
- C. Shoring and Bracing: Provide all materials and services necessary to properly engineer and construct shoring for excavations. Selection of materials and design of shoring, underpinning, and bracing of new and existing structures shall be solely the responsibility of the Contractor.
 - 1. Shoring design shall comply with State of California Trenching and Shoring Manual issued by Offices of Structure Construction; 2011.
- D. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- E. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored, per Cal/OSHA requirements for Type C Soil.
 - 1. Machine slope banks to angle of repose or less, until shored.
- F. Do not interfere with 45 degree bearing splay of foundations.
- G. Cut utility trenches wide enough to allow inspection of installed utilities.
- H. Hand trim excavations. Cut through tree roots with a sharp axe. Remove loose matter.
- I. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume. See geotechnical report (if any) for removal of larger material.
- J. At no additional cost, correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.
- K. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- L. Remove excavated material that is unsuitable for re-use from site.
- M. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- N. Remove excess excavated material from site.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load bearing excavated surfaces before placement of foundations.
- C. Scarification, over excavation and all other excavations will be subject to the approval of the Soils Engineer.

3.05 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section compliments and shall be coordinated with the Civil Drawings/requirements and the Geotechnical Report. The most stringent requirements shall be utilized.
- B. Backfilling and compacting for utilities from 5 feet outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Site grading.
- B. Section 31 23 16 - Excavation: Building and foundation excavating.
- C. Section 31 23 23 - Fill: Backfilling at building and foundations.
- D. Section 33 11 16 - Site Water Distribution Piping: Potable Water Systems.
- E. Section 33 31 11 - Site Sanitary Sewerage Systems: Sewer piping from building to municipal sewer.
- F. Section 33 41 11 - Site Storm Drainage System: Storm drainage piping from building to municipal storm drain system.
- G. Section 33 51 11 - Site Natural Gas Distribution.
- H. See Geotechnical report (if any) for findings of subsurface materials.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCES

- A. Code Compliance: See Section 01 40 00 quality requirements
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010
- C. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018 is current; use 2018 as indicated in 2022 CBC Referenced Standards.
- D. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.

- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- H. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Comply with the requirements listed in Section 31 23 23 - Fill.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.06 COORDINATION OF SPECIFICATION REQUIREMENTS

- A. Coordinate these Specification Section requirements with specifications included on the drawings and in the project geotechnical report. Comply with more stringent requirements and with those requirements of the authorities having jurisdiction and the testing geotechnical engineer during construction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where designated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

- A. For fill materials see Section 31 23 23 - Fill.
- B. For bed materials see Section 31 23 23 - Fill.
- C. General Fill: Subsoil excavated on-site.
- D. Structural Fill: Subsoil excavated on-site.
- E. Concrete for Fill: As specified in Section 03 30 00; compressive strength of 2500 psi (17.235 MPa).
- F. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material, and debris.
 - 1. Graded in accordance with ASTM C136, within the following limits:
 - a. 3/4-inch (19 mm) sieve: 95 to 100 percent passing.
- G. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
 - 1. Grade in accordance with ASTM D2487 Group Symbol GM.

- H. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
 - 1. Grade in accordance with ASTM D2487 Group Symbol SW.
- I. Topsoil: Topsoil excavated on-site.
 - 1. Select.
 - 2. Graded.
 - 3. Free of roots, rocks larger than 1/2-inch (12 mm), subsoil, debris, large weeds, and foreign matter.
 - 4. Acidity range (pH) of 5.5 to 7.5.
 - 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 - 6. Conforming to ASTM D2487 Group Symbol OH.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

3.03 TRENCHING

- A. Excavate subsoil required for conduits, storm drain, sanitary sewer, water, and gas piping to municipal utilities.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
 - 1. Hand trim for bell and spigot pipe joints.

- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- K. Remove excess excavated material from site.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.
- D. Support pipe and conduit during placement and compaction of bedding fill.

3.05 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb, or damage installed piping and conduits, or other work.
- D. Systematically fill and compact to achieve 90 percent relative compaction (or as otherwise noted in the geotechnical report) without damaging conduit or pipe. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches (150 mm) compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8-inches (200 mm) compacted depth or as directed by the Geotechnical Report.
- H. Slope grade away from building minimum 2-inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 or 95 percent of maximum dry density as applicable for the fill area.
- J. Compaction Density Unless Otherwise Specified or Indicated on plan or in geotechnical report:
 - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.

- 2. At other locations: 90 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping, Conduits, and Duct Bank:
 - 1. Bedding: Use Fill Type SP or SW (ASTM D2487) or SM with sand equivalent of 30 or greater per ASTM D2419, 3 inches thick, compacted to 90 percent.
 - 2. Cover with Fill Type SP, SW, SM, GM per ASTM D2487.
 - 3. Fill up to subgrade elevation.
 - 4. Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.
 - 5. Gas Piping: As required by the Gas Company.
- C. Power Conduits Beyond Power Co. Transformer:
 - 1. Bedding: Use Fill Type SP or SW (ASTM D2487) or SM with sand equivalent of 30 or greater per ASTM D2419, 3 inches thick, compacted to 90 percent.
 - 2. Cover with Fill Type SP, SW, SM, GM per ASTM D2487.
 - 3. Fill up to subgrade elevation.
 - 4. Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.
- D. Over Sub-Drainage Piping at Foundation Perimeter and Under Slabs:
 - 1. Drainage fill and geotextile fabric: Section 33 46 00.
 - 2. Cover drainage fill with general fill.
 - 3. Compact to 95 percent of maximum dry density.

3.07 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1.2 inch (30 mm) from required elevations.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1.2 inch (30 mm) from required elevations.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Control, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556 or ASTM D6938.
- C. See Section 31 23 23 for compaction density testing.
- D. Correct unauthorized excavation at no cost to Owner.
- E. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 1557 ("modified Proctor") or AASHTO T 180.

- F. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no additional cost to Owner.
- G. Correct areas over excavated by error in accordance with Section 31 23 23 - Fill.
- H. Frequency of Tests: See Section 31 22 00 - Grading.

3.09 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

3.10 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00 - Temporary Construction Facilities and Controls.
- B. Recompact fills subjected to vehicular traffic.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section compliments and shall be coordinated with the Civil Drawings/requirements and the Geotechnical Report. The most stringent requirements shall be utilized.
- B. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, and site structures.
- C. Backfilling and compacting for utilities outside the building to utility main connections.
- D. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 31 22 00 - Grading: Site grading.
- C. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.
- D. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- E. Section 31 23 16.26 - Rock Removal: Removal of rock during excavating.
- F. Project Geotechnical Report (if any).

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018 is current; use 2018 as indicated in 2022 CBC Referenced Standards.
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- E. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

- F. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.
- G. Geotechnical Report.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb (4.5 kg) sample of each type of fill; submit in air-tight containers to testing laboratory.
 - 1. Submit samples directly to Geotechnical Engineer for testing and analysis copy transmittals to Architect and Owner.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where agreed to.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

- A. All fill materials shall be in conformance with the approved Soils Report and addenda (if any).
- B. General Fill: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches (75 mm), rocks larger than 6 inches (150 mm), and debris.
 - 3. Conforming to ASTM D2487 Group Symbol SP, SW, SM, or GM.
- C. Structural Fill: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of organic matter, debris, and lumps larger than 3 inches (75 mm), rocks larger than 6 inches (150 mm). Fill shall contain at least fifty percent of material smaller than 1/4-inch in size.
 - 3. Imported fill materials: The soil shall be tested for potential contamination in accordance with DTSC protocols.
 - 4. On-site soils should only be used as specified in the Soils Report.

5. Conforming to ASTM D2487 Group Symbol SP, SW, SM, or GM.
6. Fill (SP, SW per ASTM D2487) may be used for structural backfill at the Contractor's option. However, sand shall not be placed within one foot of finished surface elevation. Material shall be free of perishable or spongy matter, trash, and all other vegetation.
- D. Concrete for Fill: As specified in Section 03 30 00; compressive strength of 2500 psi (17.235 MPa); except concrete used under footings and foundations to correct over-excavation shall be same as for footings and foundation.
- E. Granular Fill - Gravel - Fill Type GM, GW: Angular crushed washed stone; free of shale, clay, friable material and debris.
 1. Class 2 Aggregate base per CT202 and Section 26-1.02B.
 2. Graded in accordance with ASTM D2487 Group Symbol GM or GW.
- F. Granular Fill - Pea Gravel: No. 84 or 89 stone per ASTM C33.
- G. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
 1. Grade in accordance with ASTM D2487 Group Symbol SP or SW.
- H. Topsoil: Topsoil excavated on-site.
 1. Select.
 - a. The soil shall be tested for potential contamination in accordance with DTSC protocols.
 2. Graded.
 3. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds, and foreign matter.
 4. Acidity range (pH) of 5.5 to 7.5.
 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 6. Conforming to ASTM D2487 Group Symbol OH.
 7. Limit decaying matter to 5 percent of total content by volume.
- I. Blended Material: Conforming to type II material per the Uniform Standard Specifications for Public Works Construction, Off-Site Improvements.
- J. Select Fill: Excavated granular materials with not more than 10% passing the No. 200 sieve; free from lumps, clay, organic materials, and rocks greater than 3 inches.
- K. Type F - Subsoil: Reused, free of rocks larger than 3-inch size, and debris.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.

- D. Provide materials of each type from same source throughout the Work.
- E. Comply with EPA/DTSC requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify structural or other backfill materials to be reused or imported are acceptable to the satisfaction of the Geotechnical Engineer. Approval shall be obtained in advance of re-use or importation onto the site.
 - 1. The soil shall be tested for potential contamination in accordance with DTSC protocols.
 - 2. Imported fill materials shall be compatible with on-site soils in addition to being suitable for its intended use.
 - 3. Imported fill soil shall contain no rocks larger than 6-inch (150 mm) maximum dimension or as allowed by the Geotechnical Report and shall be predominantly granular in nature.
- B. Verify that survey benchmarks and intended elevations for the Work are as indicated.
- C. Identify required lines, levels, contours, and datum locations.
- D. See Section 31 22 00 for additional requirements.
- E. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
- F. Verify structural ability of unsupported walls to support imposed loads by the fill.
- G. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

3.02 PREPARATION

- A. Scarify subgrade surface to a depth of 6-inches (150 mm) to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Type II (Greenbook) or concrete fill and compact to density equal to or greater than requirements for subsequent backfill material.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95 percent of its maximum dry density in accordance with ANSI/ASTM D1557.
- E. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
 - 1. Do not disturb or damage foundation perimeter drainage and foundation waterproofing and protective cover utilities in trenches.

- D. Systematically fill and compact per geotechnical report. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6-inches (150 mm) compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8-inches (200 mm) compacted depth.
- H. Slope grade away from building minimum 2-inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
 - 1. Load-bearing foundation surfaces: Fill with concrete.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 or 95 percent of maximum dry density in subgrade zone.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
 - 2. At other locations: 90 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.
- L. Remove surplus fill and backfill materials from site.

3.04 FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Structural Fill:
 - 1. Use general fill.
 - 2. Fill up to subgrade elevations.
 - 3. Maximum depth per lift: 6-inches (150 mm), compacted.
 - 4. Compact to minimum 95 percent of maximum dry density.
- C. Under Interior Slabs-On-Grade:
 - 1. Use granular fill. Type A or B.
 - 2. Depth: 4-inches (100 mm) deep.
 - 3. Compact to 95 percent of maximum dry density.
 - 4. Cover with sand.
 - a. Depth: 2-inches (50 mm).
 - b. Compact to 95 percent of maximum dry density.
- D. At Footings:
 - 1. Use general fill.
 - 2. Fill up to subgrade elevation.
 - 3. Compact each lift to 90 percent of maximum dry density.

4. Do not backfill against unsupported foundation walls.
 5. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- E. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
1. Bedding: Use general fill.
 2. Cover with general fill.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8-inch (200 mm) lifts to 95 percent of maximum dry density.
- F. At Lawn Areas:
1. Use general fill.
 2. Compact to 90 percent of maximum dry density.
 3. See Section 31 22 00 for topsoil placement.
- G. At Planting Areas Other Than Lawns:
1. Use general fill.
 2. Compact to 90 percent of maximum dry density.
 3. See Section 31 22 00 for topsoil placement.
- H. Under Monolithic Paving:
1. Compact subsoil to 95 percent of its maximum dry density before placing fill.
 2. Use general fill.
 3. Fill up to subgrade elevation.
 4. Compact to 95 percent of maximum dry density.
 5. See Section 32 11 23 for aggregate base course placed over fill.

3.05 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch (25 mm) from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch (12 mm) from required elevations.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556 or ASTM D6938.
 1. Field inspections and testing shall be performed and submitted in accordance with requirements specified in Section 01 40 00 - Quality Requirements.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 1557 ("modified Proctor") or AASHTO T 180.

- D. Laboratory Tests and Analyses: Where backfill is required to be compacted to a specified density, tests for compliance shall be made in accordance with requirements specified in Section 01 40 00 - Quality Requirements.
- E. Density Test Method: Density tests shall be in accordance with ASTM D1556 (Sand Cone Method) procedures. Allow testing service to inspect and approve each subgrade and fill layer before further fill, backfill or construction Work is performed.
- F. Alternate Density Test Method: Field density tests may also be performed by the nuclear method in accordance with ASTM D6938, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556.
 - 1. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D6938.
 - 2. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of Work, on each different type of material encountered, and at intervals as directed by Architect or Owner's testing and inspection agency.
- G. Non-compliance: If tests indicate work does not meet specified requirements, remove work, replace, and retest.
- H. Should tests of fill or backfill indicate non-compliance with required density, Contractor shall over-excavate, recompact and retest until specified density is obtained.
 - 1. Costs and Time associated with remedial Work and retesting shall be in accordance with provisions of the General Conditions.
 - a. Retesting to demonstrate compliance shall be by a testing laboratory acceptable to Owner and shall be at Contractor's expense.
- I. Frequency of Tests:
 - 1. Footing Subgrade Testing: For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Geotechnical Engineer.
 - 2. Paved Areas and Building Slab Subgrade Testing:
 - a. Perform at least one field density test of subgrade for every 2,000 sf of paved area or building slab, but in no case fewer than three tests.
 - b. In each compacted fill layer, perform one field density test for every 2,000 sf of overlaying building slab or paved area, but in no case fewer than three tests.
- J. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

3.07 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section compliments and shall be coordinated with the Civil Drawings / requirements and the Geotechnical Report. The most stringent requirements shall be utilized.
- B. Aggregate base course.
- C. Paving aggregates.
- D. Soil sterilization.

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for base course.
- B. Section 31 23 16.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 31 23 23 - Fill: Topsoil fill at areas adjacent to aggregate base course.
- D. Section 31 23 23 - Fill: Compacted fill under base course.
- E. Section 32 11 23.43 - Aggregate Base Course for Synthetic Turf: Aggregate base for athletic synthetic turf.
- F. Section 32 12 16 - Asphalt Paving: Binder and finish asphalt courses.
- G. Section 32 13 13 - Concrete Paving: Finish concrete surface course.
- H. Section 32 17 13 - Parking Bumpers: Concrete bumpers.
- I. Section 33 46 00 – Sub-drainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 REFERENCE STANDARDS

- A. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- B. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- D. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.
- E. Standard Specifications for Public Works Construction, latest edition.
 - 1. Standard Specifications shall be as amended and adopted by authorities having jurisdiction, including the City or County.
 - 2. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications, as amended, and adopted by the authorities having jurisdiction.

3. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean Owner for purposes of the Contract.
4. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect for purposes of the Contract.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb (4.5 kg) sample of each type of aggregate; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Certificates of Conformance: Aggregate and sterilant materials.
- E. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- F. Compaction Density Test Reports.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Where reference is made to Standard Specifications, the following shall apply.
 1. Perform off-site work in public rights-of-way in accordance with requirements of authorities having jurisdiction, including Standard Specifications for Public Works Construction, as amended and adopted by those authorities. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Details for Public Works Construction, as amended and adopted by those authorities.
 2. Perform on-site Work as indicated and referenced on Contract Drawings and as specified herein.
- B. The quantity of volatile organic compounds (VOC) used in weed killer, tack coat, primer and other materials shall not exceed limits permitted under current regulations of:
 1. South Coast Air Quality Management District (AQMD).
- C. Source Quality Control: Obtain materials from one source throughout.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Aggregate Storage, General:
 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 2. Prevent contamination.
 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sub-Base Material: Existing or imported materials as recommended in geotechnical report.
- B. Aggregate: Coarse or crushed aggregate, conforming to Green Book Standard Specifications 200-2.2.
- C. Coarse Aggregate: Angular crushed stone; free of shale, clay, friable material, and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- D. Blended Aggregate: Pit run washed stone; free of shale, clay, friable material, and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- E. Medium Aggregate: Natural stone, pea gravel; washed, free of clay, shale, organic matter.
 - 1. Grade in accordance with ASTM D2487 Group Symbol GM.
- F. Fine Aggregate: Sand; conforming to Green Book Standard Specifications.
 - 1. Green Book Standard Specifications 200-2.2.
- G. Herbicide: Comply with all applicable environmental protection and hazardous materials laws and regulations.
 - 1. PENDULUM 2G GRANULE HERBICIDE, by BASF CORPORATION.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Geotextile Fabric: Non-biodegradable, non-woven.
- I. Aggregate: Must be completely free of Pyrite and Pyrrhotite minerals.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, testing of samples for compliance shall be provided before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Stockpiling:

1. Clear and level storage sites prior to stockpiling of material.
 2. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated.
 3. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Construction Manager to prevent segregation.
 4. Materials obtained from different sources shall be stockpiled separately.
- B. Soil Sterilant: Sterilize soil areas to receive paving. Apply soil sterilant in accordance with manufacturer's instructions and applicable environmental regulations. Take care to confine application to the areas to be paved.
- C. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- D. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Place and compact aggregate base material in accordance with Standard Specifications, Subsection 301-2. Place aggregate base 6" below curbs and curbs and gutters in addition to that which is shown on plan details, compacted to 95 percent, and below paving as indicated on plan and in geotechnical report recommendations.
- B. Under Bituminous Concrete Paving:
1. Compact to 95 percent of maximum dry density or as otherwise noted in the geotechnical report recommendations.
- C. Under Portland Cement Concrete Paving:
1. Compact to 95 percent of maximum dry density or as otherwise noted in the geotechnical report recommendations.
- D. Place aggregate in maximum 4-inch (100 mm) layers and roller compact to specified density.
- E. Level and contour surfaces to elevations and gradients indicated.
- F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- G. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- I. Apply herbicide to finished surface.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4-inch (6.4 mm) measured with 10 foot (3 m) straight edge.
- B. Scheduled compacted thickness: Within 1/4-inch (6.4 mm).
- C. Variation from design elevation: Within 1/2 -inch (12.8 mm).

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Compaction density testing shall be performed on compacted aggregate base course in accordance with ASTM D1556 or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace, and retest.
- E. Proof roll compacted aggregate at surfaces that are under slabs-on-grade and paving.

3.06 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section compliments and shall be coordinated with the Civil Drawings / requirements and the Geotechnical Report. The most stringent requirements shall be utilized.
- B. Asphaltic Concrete Paving
- C. Aggregates
- D. Surface Sealer
- E. Patching and Repair
- F. Weed Killer
- G. Headers and Stakes
- H. Concrete Wheel Stops
- I. Pavement Striping

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for paving and base.
- B. Section 31 23 23 - Fill: Compacted subgrade for paving.
- C. Section 32 11 23 - Aggregate Base Courses: Aggregate base course.
- D. Section 32 13 13 - Concrete Paving: Concrete curbs.
- E. Section 32 17 13 - Parking Bumpers: Concrete bumpers.
- F. Section 32 17 23.13 - Painted Pavement Markings: Concrete bumpers.
 - 1. Parking and Traffic Control Pavement Markings.
- G. Section 33 05 13 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 REFERENCE STANDARDS

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.
- B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Fourth Edition.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
- D. Standard Specifications for Public Works Construction (Greenbook), latest edition.
 - 1. Standard Specifications shall be as amended and adopted by authorities having jurisdiction, including the City or County.

2. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications, as amended, and adopted by the authorities having jurisdiction.
3. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean Owner for purposes of the Contract.
4. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect for purposes of the Contract.

1.04 SUBMITTALS

- A. Materials List: List source and quality standard for all asphaltic concrete materials.
- B. Weighmaster's Certificates or certified delivery tickets for each truckload of bituminous material delivered to site.
- C. Certificates of Conformance: Asphalt, aggregate and sterilant materials.
- D. Mix Designs: Submit designs for asphaltic concrete prepared by a materials laboratory under direct supervision of a Civil Engineer licensed in the State of California or a standard mix design proven in actual performance.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with Local Public Works Standards.
- B. Mixing Plant: Conform to Local Public Work Standards.
- C. Testing and analysis of granular base material and asphaltic concrete paving mix shall be performed under provisions of Division 1.
- D. Obtain materials from same source throughout.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for paving work on public property.
- B. Where reference is made to Standard Specifications, the following shall apply.
 1. Perform off-site work in the public right-of-way in accordance with requirements of authorities having jurisdiction.
 - a. Including Standard Specifications for Public Works Construction (Greenbook), as amended and adopted by those authorities.
 - b. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Plans for Public Works Construction, as amended, and adopted by those authorities.
 2. Perform on-site work as indicated and referenced on Contract Drawings and as specified herein.
- C. The quantity of volatile organic compounds (VOC) used in weed killer, tack coat, primer and other materials shall not exceed limits permitted under current regulations of South Coast Air Quality Management District (AQMD).

1.07 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen; or when rain is imminent.

- B. Place bitumen mixture when temperature is not more than 15 F degrees (9 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE MIX

- A. Provide hot plant mixed asphaltic concrete paving materials in accordance with Section 203-6 of Standard Specifications for Public Works Construction.

- 1. Binder Course Mix: B

- 2. Parking and Drive Aisle Wearing Course: C2

- 3. Hardscape Play Area Wearing Course: D2

- 4. Standard Specifications, PG-70-10 or PG-64-10.

- 5. Standard Specifications, C2-AR-4000.

- B. Use dry material to avoid foaming. Mix uniformly.

- C. Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

- D. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

- E. Wearing Course: 5 to 7 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

2.02 AGGREGATES

- A. Provide aggregate for base course consisting of angular crushed stone, free of shale, clay, friable material and debris.
- B. Granular base aggregate shall be in accordance with Section 200-2.2 of Standard Specifications for Public Works Construction (Greenbook).
- C. Granular base aggregate maximum size:
 - 1. Base courses 6" thick and under: $\frac{3}{4}$ inches
 - 2. Base courses over 6" thick: 1-1/2 inches
- D. Aggregates for asphaltic concrete paving shall be in accordance with Section 203.6.2.2 of Standard Specifications for Public Works Construction (Greenbook).

2.03 MATERIALS

- A. General: Aggregate base, prime coat paint binder, bituminous surface course and other materials shall be as noted on the Contract Drawings and shall comply with requirements of authorities having jurisdiction.
- B. Asphalt Cement: ASTM D 946.
- C. Aggregate for Base Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
 - 2. Crushed Aggregate Base in accordance with Standard Specifications (Greenbook), Sub-Section 200-2.2.
- D. Asphalt Concrete Materials: Standard Specifications (Greenbook), Sub-Section 203-6.
- E. Aggregate for Binder Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- F. Aggregate for Wearing Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- G. Fine Aggregate: Sand
- H. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- I. Primer: Homogeneous, medium curing, liquid asphalt.
- J. Tack Coat: Emulsified asphalt.
- K. Seal Coat: AI MS-19, slurry type.
 - 1. Guard Top by Industrial Asphalt Inc., Irwindale, CA.
 - 2. Satin Seal by Blue Diamond Co., Long Beach, CA.

3. OverKote by Diversified Asphalt Products, Anaheim, CA.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.

2.05 ACCESSORIES

- A. Headers and Stakes: 2 x 6 inch (50 x 305 mm) nominal preservative treated Douglas Fir (PTDF), except at curves provide laminated 1 x 6 inch (25 x 305 mm) nominal preservative treated Douglas Fir. Stakes, 2 x 3 x 18 inch (50 x 150 x 457 mm) long PTDF at 48 inch (1219 mm) on center maximum. Use hot dipped galvanized nails only.
- B. Pavement Reinforcing Fabric: Petromat by Amoco Fabrics and Fibers Co., Austell, GA (800) 445-7732, or approved equal. Non-woven polypropylene fabric conforming to Standard Specifications, Sub-Section 213-1.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Refer to Geotechnical Report referenced in Section 00 31 00 - Available Project Information, provided under separate cover, notes on Contract Drawings, and requirements of authorities having jurisdiction.
- B. Verify that compacted subgrade and granular base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Fine grading, checking, shaping, and compacting of subgrade shall be complete before start of asphaltic concrete work.
- E. Soil Sterilant: Sterilize soil areas to receive asphaltic concrete paving. Apply soil sterilant in accordance with manufacturer's instructions and applicable environmental regulations. Take care to confine application to the areas to be paved. See Section 32 11 23 - Aggregate Base Courses for product information.
- F. Curbs and Gutters: Gutters shall be in place and cured prior to start of asphaltic concrete work. Provide lumber ramping at all locations where rolling equipment or vehicles cross new concrete paving, curbs and gutters.
- G. Headers: Place headers with tops flush with finish asphaltic concrete surfaces. Back headers with stakes.

3.02 BASE COURSE

- A. Place and compact base course.

3.03 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 0.10 gal/sq yd (0.32 L/sq m).

- C. Apply tack coat to contact surfaces of curbs, gutters and previously placed or existing paving.
- D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.
- E. Joining Pavement: Expose, cut and clean edges of existing pavement to straight, vertical surfaces for full depth of existing pavement. Paint edge with asphalt emulsion before placing new asphaltic concrete. Joints in new paving shall be in accordance with Standard Specifications.

3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install work in accordance with the Standard Specifications for Public Works Construction (Greenbook), latest edition, Municipality of the City, or County Public Work's Standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place thickness as indicated on Civil Drawings to minimum 2 inch (51 mm) compacted thickness.
- D. Install gutter drainage grates and frames and manhole frames in correct position and elevation.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
 - 1. Compact (roll) asphaltic concrete in accordance with Standard Specifications (Greenbook), Sub-Section 302-5.6, using machine rollers.
 - a. Compaction by vehicular traffic is prohibited.
 - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- F. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.05 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Install work in accordance with Standard Specifications (Greenbook), Sub-Section 302-5.
- B. Place asphalt binder course within 24 hours of applying primer or tack coat.
- C. Place binder course to thickness of 2 inches minimum (51 mm) compacted thickness.
- D. Place wearing course within two hours of placing and compacting binder course.
- E. Place wearing course to thickness of 2 inches minimum (51 mm) compacted thickness.
- F. Install gutter drainage grates and frames and manhole frames in correct position and elevation.
- G. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
 - 1. Compact (roll) asphaltic concrete in accordance with Standard Specifications (Greenbook), Sub-Section 302-5.6, using machine rollers.
 - a. Compaction by vehicular traffic is prohibited.

- b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- H. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.06 CURBS

- A. Install extruded asphalt curbs of standard profile as indicated by plan detail or referenced standard detail.

3.07 SEAL COAT

- A. Apply seal coat after surface course application, in accordance with manufacturer's recommendations.
- B. Apply seal coat to surface course and asphalt curbs in accordance with Standard Specifications (Greenbook), Sub-Section 302-8.2.
- C. Add water to specified seal coat material. When air temperatures of 90 degrees F or more are encountered during application, consult manufacturer for recommendations.
- D. If pavement surface exhibits imperfections of roller marks, rock pockets, ridges or depressions as determined by the Architect, the addition of sand aggregate to seal coat, and amounts thereof, shall be as recommended by the manufacturer.
- E. A second application shall be made after first coat has dried to the touch. When sand is added to the first seal coat, two additional coats without extra sand shall be applied.
- F. Allow seal coat to dry before permitting traffic or striping.

3.08 PAVEMENT REPAIR AND PAVING

- A. Preparation of existing pavement: Where indicated, remove loose asphaltic concrete, cleanout "potholes" and cracks, remove dirt, oil and other foreign materials.
- B. Repair holes with full paving section as specified. Repair "alligating" with asphalt "skin-patch". Fill all cracks larger than 1/4 inch (6 mm) wide with asphalt emulsion slurry.
- C. Tack Coat: Apply asphalt oil AR-4000 or AR-8000, as required for jobsite condition, at metered application rate of no less than a range from 0.2 to 0.3 gallons per square yard of fabric or as directed by manufacturer and to provide 100 percent fabric saturation and ample bonding for paving section.
- D. Fabric Reinforcement: Place fabric smooth side up in tack coat with 2 to 4 inch overlap. Hand-broom to remove wrinkles. Apply additional tack coat to joints and between overlapped fabric layers.
- E. Overlay Asphalt: Place single course asphalt, 1-1/2 inch (38 mm) compacted thickness, in conformance with specified standards in this section.

3.09 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch (6 mm) measured with 10 foot (3 m) straight edge.
- B. Compacted Thickness: Within 1/4 inch (6 mm) of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch (12 mm).

3.10 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.
- C. Test: Flood test all paving to demonstrate positive drainage. No standing water shall remain 1 hour after test.
- D. Asphalt paving used on pedestrian and accessible areas shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.

3.11 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F (60 degrees C).
 - 1. After final rolling, prohibit all traffic on asphaltic concrete until mix has fully cooled and set. Minimum time, in all cases shall be 6 hours.

3.12 CLEANING

- A. After completion of paving operations, clean all existing and new improvements that have been soiled, especially by oil tracking from asphalt tanks or placement in general.
- B. For Substantial Completion review, broom clean and wash paving with hoses. Clean residue from landscaping installation.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section compliments and shall be coordinated with the Civil Drawings / requirements and the Geotechnical Report. The most stringent requirements shall be utilized.
- B. Concrete sidewalks, integral curbs, and gutters.
- C. Integrally colored Portland cement concrete paving.

1.02 RELATED REQUIREMENTS

- A. Section 31 22 00 - Grading: Preparation of site for paving and base.
- B. Section 31 23 23 - Fill: Compacted subbase for paving.
- C. Section 32 17 26 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.
- D. Section 32 17 23.13 - Painted Pavement Markings: Pavement markings.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2014 is current; use 2004a as indicated in 2022 CBC Referenced Standards.
- G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2011a is current; use 2018 as indicated in 2022 CBC Referenced Standards.
- H. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014 is current; use 2004a as indicated in 2022 CBC Referenced Standards.
- J. ASTM C150/C150M - Standard Specification for Portland Cement; 2012 is current; use 2007 as indicated in 2022 CBC Referenced Standards.
- K. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

- L. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- M. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- N. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).
- O. Standard Specifications for Public Works Construction, latest edition.
 - 1. Standard Specifications shall be as amended and adopted by local authorities having jurisdiction, including but not limited to County, City, Town, or other.
 - 2. Where reference is made to Standard Details, such reference shall be to the Standard Details accompanying the Standard Specifications, as amended and adopted by the authorities having jurisdiction.
 - 3. Wherever term "Agency" occurs in Standard Specifications, it shall be understood to mean Owner for purposes of the Contract.
 - 4. Wherever term "Engineer" occurs in Standard Specifications, it shall be understood to mean Architect for purposes of the Contract.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Mix Design: Design mixes for each concrete mix.
- C. Product Data: Provide data on joint filler, admixtures, and curing compound.
 - 1. Material Certificates signed by manufacturers for each of the following:
 - a. Cementitious materials and aggregates.
 - b. Steel reinforcement and reinforcement accessories.
 - c. Admixtures.
 - d. Curing compounds.
 - e. Joint fillers.
 - 2. Colored concrete product data and color selections.
- D. Samples: Submit two sample panels, 12 x 12 inch (300 x 300 mm) in size illustrating exposed aggregate finish.
- E. Shop drawings: For pattern layout and verification.

1.05 QUALITY ASSURANCE

- A. Industry Standard: Perform concrete paving Work in accordance with ACI 301.
- B. Regulatory Requirements: Where reference is made to Standard Specifications, the following shall apply:
 - 1. Where reference is made to Standard Specifications, the following shall apply:
 - a. Perform off-site Work in public rights-of-way as indicated on the Contract Drawings and in accordance with requirements of authorities having

jurisdiction, including Standard Specifications for Public Works Construction, as amended and adopted those authorities.

- 1) For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Details for Public Works Construction, as amended and adopted those authorities.
- b. Perform on-site work as indicated and referenced on the Contract Drawings and as specified herein.
2. Conform to Standard Specifications for Public Works Construction.
3. Conform to California Code of Regulations (CCR), Volume 2, Part 2, Chapters 18A and 19A.
4. Conform to California Building Code (CBC), Chapter 11B and ADAAG for accessibility requirements.
 - a. Concrete paving and concrete finishes along accessible routes of travel shall be at least as slip-resistant as that described as a medium salted finish for slopes of less than 6%, and slip resistant at slopes of 6% or greater; CBC sections 11B-302 and 11B-403.
5. Comply with OSHA and Cal-OSHA requirements.
6. Continuous surfaces, including walks and sidewalks, shall have a continuous common surface, not interrupted by steps or by abrupt changes in level exceeding 1/4 inch (3 mm) vertical (CBC 11B-303.2), or beveled at 1:2 slope to a maximum height of 1/2 inch (12 mm) (CBC 11B-303.3) and shall have a minimum width of 48 inches (1219 mm); CBC 11B-403.5.1.
7. Surface cross slopes shall not exceed 2 percent on any accessible path of travel.
8. Surface slopes shall not exceed 2 percent in any direction for areas of flatwork that have no discernable path of travel. These areas are also known as plaza areas.
- C. Source Quality Control: Obtain like materials from one source throughout.
- D. Lines and Levels: Established by State of California licensed Surveyor or registered Civil Engineer. Costs of surveying services shall be included in the Contract Sum.
- E. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.

1.06 MOCK-UP

- A. Install minimum 48 x 48 inch (1219 x 1219 mm) mock-up of concrete flatwork for each texture or color specified.
- B. Install mock-up one month prior to installation, located where directed by Architect.
- C. Use identical forming system, subgrade type, reinforcing, expansion joints, score joints, finishing and edge trim as specified for installation.
- D. Architect approval required prior to proceeding with finish installation. Acceptable sample shall serve as quality basis for evaluating subsequent work.
 1. Refinish mock-up area as required to produce acceptable work.
 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

- E. Mock-up may not be used in final installation. Remove mock-up materials from site and dispose of legally.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Delivery, Storage and Handling: Comply with requirements specified for regular concrete in Section 03 30 00 - Cast in Place Concrete.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI 301.
- B. Comply with Geotechnical Report recommendations.
- C. Concrete Sidewalks: 2,500 psi (17.2 MPa) 28-day concrete, thickness as indicated on Civil drawings, minimum 4 inches (100 mm), natural grey color Portland cement. Concrete thickness and psi recommendations in Geotechnical Report shall be used, if thicker and stronger.
- D. Parking Area Pavement: 3,250 psi (20.7 MPa) 28-day concrete, thickness as indicated on Civil drawings, #4 reinforcing bars, 18 inches on-center, each direction at the mid-height of the slab, finish as indicated on drawings. Concrete thickness and psi recommendations in Geotechnical Report shall be used, if thicker and stronger.

2.02 FORM MATERIALS

- A. Wood form material, profiled to suit conditions.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
 - 1. Thickness: 1/2 inch (12 mm).

2.03 REINFORCEMENT

- A. General: As indicated on drawings. Reinforcement for portland cement concrete paving in public rights-of-way shall comply with all applicable requirements in the Standard Specifications for Public Works Construction and Standard Details, as adopted by local authorities having jurisdiction.
- B. Reinforcing Steel: ASTM A615/A615M Grade 60 (420); deformed billet steel bars; unfinished finish.
 - 1. Unless detailed otherwise on drawings, provide number 4 reinforcing bars at 18 inches (610 mm) on center, each way.
- C. Tie Wires: 18 gage minimum, black annealed steel.
- D. Construction Joint Reinforcing:
 - 1. Dowels: ASTM A615/A615M, Grade 60 - 60,000 psi (420 MPa) yield strength; deformed billet steel bars; unfinished finish.
- E. Comply with Geotechnical Report recommendations.

2.04 PERFORMANCE REQUIREMENTS

- A. Albedo reflectance of finish concrete shall be minimum 0.30.

2.05 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M Sulfate Resistant - Type V portland type, grey color.
- C. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- D. Water: Clean, and not detrimental to concrete.
- E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979.
 - 1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
 - 2. Packaging: If pigments are to be added to mix at site, furnish pigments in premeasured disintegrating bags to minimize job site waste.
 - 3. Color(s): As selected by Architect from manufacturer's full range.
 - a. Allow for three different pigment colors.
 - 4. Products:
 - a. BRICKFORM; BRICKFORM Liquid Integral Color: www.brickform.com.
 - b. Butterfield Color: www.butterfieldcolor.com.
 - c. Davis Colors: www.daviscolors.com.
 - d. Lambert Corporation: www.lambertusa.com.
 - e. L.M. Scofield Company: www.scofield.com.
 - f. Solomon Colors: www.solomoncolors.com.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing, Type B - Retarding, Type D - Water Reducing and Retarding, Type F - Water Reducing, High Range, and Type G - Water Reducing, High Range and Retarding.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.06 ACCESSORIES

- A. Liquid Curing Compound: ASTM C 309, Type 1, Class A. Comply with all applicable air pollution requirements.
- B. Liquid Surface Sealer:
 - 1. High solids, acrylic curing and sealing compound: Minimum 30% non-yellowing, acrylic solids curing compound; shall conform to ASTM C 309 and ASTM C 1315, Type I, Class A, VOC compliant.
 - a. Acceptable Products:
 - 1) L&M Construction Chemicals, Inc.; Dress & Seal WB: www.lmcc.com.
 - 2) L.M. Scofield Company; Cureseal-W: www.scofield.com.
 - 3) W. R. Meadows Company; Decra-Seal W/B: www.wrmeadows.com.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
- C. Surface Retarder:
 - 1. Color: As selected by Architect from manufacturer's custom range.
 - 2. Acceptable Products:

- a. Preco EAC-S, manufactured by Fosroc, Inc., Georgetown, KY, or approved equal.
 - b. WR Grace; Grace Top Cast: www.graceconstruction.com
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Tactile Warning Surfaces: See Section 32 17 26.
- E. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
 - 1. Color: Gray.
 - 2. Applications: Use for:
 - a. Joints in sidewalks and vehicular paving.
 - 3. Products:
 - a. Pecora Corporation; NR-201 Self-Leveling Traffic and Loop Sealant: www.pecora.com.
 - b. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - c. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: www.sherwin-williams.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Soil Sterilant: As specified in Standard Specifications for Public Works Construction. Soil sterilant shall comply with all applicable environmental protection and hazardous materials laws and regulations.
 - 1. See Section 32 11 23 - Aggregate Base Course for product.
- G. Headers and Stakes: Pressure preservative treated Douglas Fir, 2 x 6 inch (50 x 150 mm) nominal size except at curves provide laminated 1 x 6 inch (25 x 150 mm). Use hot dipped galvanized nails only.
- H. Expansion Joint Filler: ASTM D1751, pre-molded, compressible 1/2 inch (12 mm) thick non-extruding bituminous type resilient filler, compatible with joint backing and sealing products.

2.07 PATTERN STAMPED CONCRETE:

- A. Stamping Patterns: Lithotex Pavecrafters by L.M. Scofield Company, Los Angeles, CA (800/800-9900); www.scofield.com.
 - 1. Alternate Manufacturers:
 - a. The Bomanite Company; www.bomanite.com
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Pattern-matched interlocking tools, manufacturer's rigid design.
- C. Pattern as indicated.
 - 1. Provide custom pattern where indicated or not included in manufacturer's standard selections.

2.08 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

- B. Concrete Mix for Pedestrian (Sidewalk) Pavements, Natural Color, unless indicated otherwise: Standard Specification for Public Works Construction, Section 201-1.1.2 - Class 520-C-2500, with maximum slump of 4-inches, except concrete paving in public rights of way shall be as required authorities having jurisdiction.
- C. Concrete Mix for Trash Enclosure and other Exterior Slabs on Grade: ASTM C94 - Ready-Mixed Concrete, Alternative No. 2, minimum 28- day compressive strength as indicated on Drawings or, if not indicated, 3,000 psi.
- D. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- E. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
 - 1. Use accelerating admixtures in cold weather or set retarding admixtures in hot weather only when approved by Architect. Do not use calcium chloride.
- F. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
- G. Concrete Properties:
 - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; As scheduled.
 - 2. Water-Cement Ratio: Maximum 50 percent by weight.
 - 3. Maximum Slump: 4 inches (100 mm).

2.09 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted stabilized soil is acceptable and ready to support paving and imposed loads.
 - 1. Provide as indicated on Civil Drawings, as specified in Earthwork Sections and as recommended in geotechnical report reference in Section 02 32 00 - Geotechnical Data.
- B. Fine grading, checking, shaping, and compacting of subgrade shall be complete before start of concrete paving Work.
- C. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 32 11 23 Aggregate Base Course for construction of base course for work of this Section.

- B. For pavement subject to vehicular traffic, provide sub-base and aggregate base material specified in Section 32 11 23 - Aggregate Base Courses and as indicated on the Drawings.
- C. Aggregate base is not required under Portland cement concrete paving subject only to pedestrian traffic in normal use.

3.03 PREPARATION

- A. Project Conditions:
 - 1. Water and Dust Control: Maintain control of concrete dust and water at all times. Do not allow adjacent planting areas to be contaminated.
 - 2. Do not place pavement when base surface or ambient temperature is less than 40 degrees F (4 degrees C) or if base surface is wet or frozen.
 - 3. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Moisten base to minimize absorption of water from fresh concrete. Do not place concrete on standing water.
- C. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- D. Notify Architect a minimum of 24 hours prior to commencement of concreting operations.
- E. Curbs and Gutters: Schedule Portland cement concrete curbs and gutters to be in place and cured prior to start of adjoining asphaltic concrete and Portland cement concrete paving work.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
 - 1. Surfaces and Edges: Except where special finishes and tooled edges are indicated, provide all exposed finish surfaces of dense concrete with sharp arises and outside corners.
 - 2. Recesses and Openings: As indicated on Drawings or as directed.
- B. Concrete Formwork:
 - 1. Construct formwork accurately and to configurations and dimensions indicated for finish concrete Work.
 - 2. Formwork shall be substantial, mortar-tight and braced to maintain position and shape during placement of reinforcing and concrete.
 - 3. Hold forms rigidly in place by stakes, clamps, spreaders and braces where required to ensure rigidity.
 - 4. Curbs:
 - a. Construct curb forms with smooth side placed next to exposed concrete face.
 - b. Curb forms shall have true, smooth upper edge.
 - c. Depth of curb forms at back of curbs shall be equal to full depth of curb.
 - d. Depth of face forms shall be equal to full face height of curb.

- e. Benders or thin plank forms may be used to form curves and at grade changes and curb returns.
- f. Back forms for curb returns may be made of 1/2 inch (12 mm) thick benders cleated together for full depth of the curb.
- 5. Formwork shall not deviate more than 1/4 inch (6 mm) maximum from required positions and levels.
- 6. Verify formwork alignment and levels as Work proceeds, promptly making adjustments and adding bracing as necessary.
- C. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
 - 1. Remove the form on the front of curbs in not less than one hour nor more than 6 hours after the concrete has been placed.
 - 2. Remove side forms for sidewalks, gutter depressions, island paving and driveways, not less than 12 hours after the finishing has been completed.
- D. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement at mid-height of slabs-on-grade.
- B. Reinforcement Placement, General: Locate reinforcement as indicated on Drawings or in Standard Specifications, whichever is more stringent.
 - 1. Locate reinforcement to provide required cover by concrete. If not otherwise indicated on Drawings or in Standard Specifications, provide concrete cover in compliance with ACI 318, Table 20.5.1.3.1.
 - 2. Place, support and secure reinforcement against displacement.
- C. Reinforcement Spacing: Space reinforcement as indicated on Drawings or in Standard Specifications, whichever is more stringent. If not indicated, maintain clear spacing of two times bar diameter but not less than 1-1/2 inch (38 mm) nor less than 1-1/3 times maximum size aggregate.
- D. Coordination: Locate reinforcement to accommodate embedded products and formed openings and recesses.
- E. Reinforcement Supports: Provide load bearing pads under supports or provide precast concrete block bar supports.
- F. Interrupt reinforcement at contraction and expansion joints.
 - 1. Provide doweled joints 24" O.C. with one end of dowel set in capped sleeve to allow longitudinal movement.
- G. Place dowels to achieve pavement and curb alignment as detailed.
 - 1. Secure tie dowels in place before depositing concrete. Provide No. 3 bars, 18 inch (457 mm) long at 24 inches (610 mm) O.C. for securing dowels where no other reinforcement is provided.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.

- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Mixing: If batch plant is within travel time not exceeding maximum limits, transit mix concrete in accordance with ASTM C94. If travel time exceeds limits, provide alternative means for mixing and submit for review and approval.
- B. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
- C. Place concrete in accordance with ACI 304R.
- D. Do not place concrete when base surface is wet.
- E. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- F. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- G. Use internal vibration to consolidate concrete around reinforcing per industry guidelines.
- H. Place concrete to pattern indicated.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 1/2 inch (12 mm) wide expansion joints as indicated on Drawings (if not indicated provide at 20 foot (6 m) intervals) and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Place in all concrete walks, other exterior flatwork and concrete curbs and gutters.
 - 2. If expansion joints are not indicated, comply with standard details and specifications of authorities having jurisdiction, including Standard Details for Public Works Construction and Standard Specification for Public Works Construction, as applicable.
 - 3. Place expansion control filler to correct elevation and profile. Form joints with joint filler extending from bottom of pavement to within 1/2 inch (13 mm) of finished surface.
 - 4. Secure to resist movement by wet concrete.
 - 5. Coordinate locations to align expansion joints in adjoining concrete walks, curbs, gutters and other exterior flatwork.
 - 6. Provide expansion joints also at beginning and end of all curved segments.
 - 7. Provide expansion joints also at intersections of concrete curbs and gutters and building footing.
 - 8. Provide expansion joints also at intersections of concrete paving and building footing.

9. Lay out expansion joint locations to occur where possible at penetrations such as handrail posts and columns.
 10. Place expansion control filler to correct elevation and profile.
- C. Provide scored joints:
1. As indicated on Drawings. If not indicated, locate joints in compliance with Standard Details and as indicated below.
 2. Evenly spaced at maximum 5 feet (1.5 m) intervals for vehicular paving and 5 feet (1.5 m) for pedestrian paving.
 3. Between sidewalks and curbs.
 4. Between curbs and pavement.
 5. Lay out control joint locations to occur at penetrations such as handrail posts and columns and where shown on Drawings.
 6. Refer to Architectural, Landscape and Civil Drawings for additional information and joint locations.
- D. Provide keyed joints as indicated.
- E. Saw cut contraction joints 1/8 inch (3 mm) wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.09 EXPOSED AGGREGATE

- A. Wash scheduled concrete surfaces with acid etch solution exposing aggregate to match sample panel.
- B. Decorative Scoring at Exposed Aggregate Flatwork: Pattern as indicated.
1. Use saw-cuts 1/8-inch wide by one-fourth of slab depth, unless otherwise indicated. Commence work as soon as possible after concrete placement as recommended by Soff-Cut International, Corona, CA (800/776-3328).

3.10 FINISHING

- A. Concrete Paving Finish: ACI 301, two-step trowel finish, followed after surface has achieved initial set by flooding of surface and light rubbing with bristle brush so that concrete fines are exposed slightly.
1. Finish surface less than 6 percent shall receive medium broom finish resembling medium grit sandpaper. CBC 11B-403 and 11B-302.1.
 2. Finish surface greater than 6 percent shall receive heavy broom finish. CBC 11B-403 and 11B-302.1.
 3. Surfaces shall have static coefficients of friction of 1.3 to 1.6 (dry) and 1.2 to 1.4 (wet) when field tested in accordance with ASTM C1028.
 4. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/8 inch (3 mm) radius.
1. Broomed: Pull broom across freshly floated concrete to produce medium texture in straight lines perpendicular to main line of traffic. Do not dampen brooms.

2. Tooled Joints: 1-inch deep by 3/16-inch wide tooled joints with 1/8-inch radius corners.
- C. Enhanced Sidewalk Paving: Light sandblast look finish using surface retarder.
 1. Apply surface retarder in strict compliance with manufacturer's specifications and instructions.
 2. Surface retarder shall be applied after concrete surface has been finished and while concrete is still moist.
 - a. Apply with a Hudson type sprayer with an adjustable or fan type nozzle with a .3-.5 gpm flow rate.
 - 1) Apply at the rate of 175-350 sf/gal.
 - b. Once surface retarder is applied, protect per manufacturer's specifications.
 - c. Begin washing surface retarder off surface of concrete after 12 to 16 hours.
 - 1) Wash with a power washer with 1500 psi and a 25 degree fan nozzle.
 - 2) Keep power washer tip 6 to 10 inches away from surface of concrete to avoid deep scour marks.
 - 3) A stiff bristle brush may be used to help achieve the desired finish.
 - 4) Wash until clear water runs off the surface of the concrete paving.
 - d. Allow concrete to dry and cure before applying sealer.
 - e. Apply sealer per sealer manufacturer's specifications.
- D. Curbs and Gutters: Comply with Standard Specifications.
- E. Specific Finishes:
 1. Salt Finish (Rock Salt):
 - a. Tamp concrete sufficiently to bring fines to surface. Bring to required grade with wood floats and steel trowel smooth.
 - b. Apply heavy textured salt finish, composed of particles 1/4-inch to 3/8-inch in size on approximately 80 percent of each square foot of concrete surface.
 - 1) Sprinkle salt on concrete and press into surface leaving only tops of salt grains exposed.
 - c. After 24 hours, wash salt away with water and brush.
 - d. Allow surface and impressions to dry before applying curing compound.
 - e. Match approved mock-up sample panel.
 2. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it is not slippery. Do not over-trowel or burnish the surface.
- F. Curing and Sealing:
 1. Place sealer on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
 2. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 Plastic Shrinkage Cracking published by the National Ready Mixed Concrete Association.
 3. Do not cover concrete with plastic sheeting.

3.11 JOINT SEALING

- A. See Section 07 92 00 - Joint Sealants for joint sealer requirements.

3.12 TOLERANCES

- A. ACI 301, Class B, except paving in public rights-of-way shall comply with the Standard Specifications.
- B. Maximum Variation of Surface Flatness: 1/4 inch (6 mm) in 10 ft (3 m).
- C. Maximum Variation from True Position: 1/4 inch (6 mm).

3.13 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd (57 cu m) or less of each class of concrete placed each day.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.14 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavement until 75 percent design strength of concrete has been achieved.
- C. Prohibit all vehicular traffic across pedestrian paving unless suitable base and reinforcement have been added.
- D. Provide lumber ramping and plywood covering where curbs and gutters are subject to vehicular and equipment traffic during construction.
- E. Provide protection of colored concrete in accordance with colored concrete manufacturer's instructions and recommendations.

END OF SECTION